Chapter Fifty-Three

PAVEMENT REHABILITATION

BUREAU OF DESIGN AND ENVIRONMENT MANUAL

Chapter Fifty-Three
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CHAPTER FIFTY-THREE

PAVEMENT REHABILITATION

Chapter 53 documents the Department's policies and procedures for pavement rehabilitation. It will assist in assessing the pavement, recognizing the difference between structural deficiencies and surface defects, and determining an appropriate rehabilitation strategy for the facility.

53-1 PAVEMENT CONDITION AND DISTRESS DATA RESOURCES

53-1.01 Condition Rating Survey (CRS)

The IDOT Condition Rating Survey (CRS) Program was established in 1974 to assure the uniform collection and inventory of pavement condition data for use by the Department in planning functions. The CRS is a good measure of the subjective view of overall pavement distress conditions. The trend of CRS over time is useful in evaluating the existing pavement and in selecting the rehabilitation alternative. The pavement is categorized according to the following programmatic definitions:

1. Poor ($1.0 \leq CRS \leq 4.5$). The pavement is critically deficient and in need of immediate improvement.

2. Fair ($4.6 \leq CRS \leq 6.0$). The pavement is approaching a condition that will likely necessitate improvement over the short term.

3. Satisfactory ($6.1 \leq CRS \leq 7.5$). The pavement is in acceptable condition (low end) to good condition (high end) and not in need of improvement.

4. Excellent ($7.6 \leq CRS \leq 9.0$). The pavement is in excellent condition.

CRS information is stored in the Illinois Roadway System (IRIS). See Section 53-1.03(a) for more information concerning CRS.

53-1.02 Data Collection Vehicles (DCVs)

53-1.02(a) Data Collection System

Since 1993, the Office of Planning and Programming (OPP), in cooperation with the Bureau of Materials and Physical Research (BMPR), has used DCVs to collect information on the entire State-maintained highway system and other pavements, as requested. Using DCVs provides for safer and more effective data collection than a manual survey of the entire highway system, and the Department's manpower resources are more effectively utilized. The Data Collection Vehicle images and sensor data can be used to:

- conduct condition rating surveys (CRS),
- identify rough roads,
- identify areas of high rutting, and
- monitor ride quality.

Information concerning the CRS for the State-maintained system is available from OPP.

The Department also uses DCVs to record data on Interstate pavements annually and on non-Interstate pavements biennially. The BMPR publishes an annual report for Interstates based on the automated roughness and rut depth sensor data collected. In addition, inventories of signs, bridges, and guardrails may be compiled without leaving the office.

53-1.02(b) Workstations and Data Access

To access the DCV's data, workstations are made available to IDOT personnel in each district and in the OPP and the BMPR. A historical database of the pavement images and sensor information collected is maintained by the Department to assess the pavement performance of highway segments over time. Pavement roughness, rutting, faulting, and CRS information collected by DCVs and processed at workstations is available on the Illinois Roadway Information System (IRIS). See Section 53-1.03(c).

53-1.02(c) Test Requests

If current data from the district or OPP is unsuitable or unavailable, contact the Office of Planning and Programming, System Performance Manager or Engineer of Pavement Technology in the BMPR to request testing. The Department has limited resources available to accommodate special requests for DCVs that are made by districts and local agencies.

53-1.03 Information Databases

The following sections describe the IDOT information databases that are available to the pavement rehabilitation engineer.

53-1.03(a) Illinois Pavement Feedback System (IPFS)

The IPFS database was developed by the University of Illinois and the BMPR. It contains historical data on the Interstate and supplemental freeway system. The IPFS includes data on:

- original pavement construction;
- subsequent pavement rehabilitation;
- pavement distress history;
- traffic history;
- CRS history; and
- IRI, rutting, and faulting history.

Data is tabulated every 0.1 mile by the marked mile post. Historical information is available for every year from 1994 forward. The IPFS is maintained by the BMPR. For additional information on the database, contact the Pavement Technology Engineer of the BMPR.

53-1.03(b) Pavement Management File (PMF)

The PMF database was developed by the BDE and exists as one of the available databases in the IPFS (see Section 53-1.03(a)). The Pavement Review Team (PRT) visually surveys the Illinois Interstate and supplemental freeway system in odd-numbered years using the DCV videos. The pavement priority and distress information collected by the PRT is useful to pavement rehabilitation engineers as it contains original construction and rehabilitation information for individual pavement sections as well as current pavement distress data, traffic data, and past CRS history.

53-1.03(c) Illinois Roadway Information System (IRIS)

The IRIS database was developed by the OPP and contains an inventory of all highways, both IDOT and non-IDOT. District Bureaus of Program Development are responsible for data collection activities using resources within their respective districts. The data are collected for the entire width between the right-of-way lines for all public highways. IRIS roadway information is collected for two primary reasons — to qualify for funding and to prioritize highway rehabilitation needs.

For State highways, the IRIS database includes CRS history, traffic information, legislative information, pavement type, and location reference points. The pavement rutting, roughness, and faulting data contained in IRIS are the average values over the CRS section which were collected in the most recent survey. See Section 53-1.04 for additional information on rutting, roughness, and faulting data. The IRIS data typically are the most recent available from IDOT. There are very little historical CRS data stored in IRIS. However, annual copies of all IRIS files are prepared and retained indefinitely for reference purposes. The IRIS can be accessed through the Department's IBM mainframe (IMSA System).

For additional information on the database, contact OPP.

53-1.04 Rutting, Roughness, and Faulting Data

Pavement rutting, roughness, and faulting data are collected and processed by the BMPR annually on the Interstate system and annually on alternating halves of the primary highway system. This information is available to all IDOT districts to help determine the need for rehabilitation and to assist in selecting the appropriate rehabilitation strategy.

53-1.04(a) Rutting Data

Pavement rutting data (i.e., rut depth) is collected for both PCC and AC pavement types. Rutting on PCC pavements usually is an indication of pavement wear. The presence and depth of ruts on AC pavements are a concern. The presence of rutting in AC pavement types can be an indication of:

- excessive pavement wear,
- an unstable AC mixture, or
- a permanent deformation in the pavement structure due to traffic loadings.

Excessively deep pavement ruts can be a significant hazard to drivers. Water can pond in ruts and create a potential for vehicular hydroplaning and excessive spray which can obscure a driver's vision.

Sensors on the DCVs are used to measure pavement rut depth. The rut depths measured in the field then are used to rate the rutting severity of the pavement section. Figure 53-1A defines the severity levels for rut depth measurements collected automatically by DCVs. Manually obtained rut depth measurements will differ from sensor data.

53-1.04(b) International Roughness Index (IRI)

Pavement roughness data collected by DCVs are based on the IRI. The IRI was originally developed by the World Bank for evaluating road conditions in developing nations. The IRI is actually the output of a mathematical model of a quarter car in which road profile is used as an input.

RUTTING SEVERITY	AVERAGE RUT DEPTH (D_r)
Low	$D_r < 0.15$ in
Medium	0.15 in $\leq D_r \leq$ 0.35 in
High	$D_r > 0.35$ in

DEFINITIONS FOR PAVEMENT RUTTING SEVERITY
(Automated Data Collected by DCVs)

Figure 53-1A

IRI values are measured in inches per mile — the higher the IRI value, the rougher the pavement. IRI values over 175 in/mi are considered unacceptable. A quartile analysis of data collected on Illinois Interstates indicates that ranges for the quartiles are as shown in Figure 53-1B. Roughness can serve as an indicator of pavement performance as well as the need for rehabilitation.

QUARTILE	IRI VALUE (in/mi)
First (Smoothest)	IRI < 80
Second	80 ≤ IRI ≤ 105
Third	106 ≤ IRI ≤ 140
Fourth (Roughest)	IRI > 140

Note: IRI values over 175 in/mi are considered unacceptable.

QUARTILE ANALYSIS OF IRI DATA ON ILLINOIS' INTERSTATES
Figure 53-1B

An annual report based on the IPFS database, *Interstate Surface Quality – An Analysis of International Roughness Index and Rut Depths on Illinois Interstate Pavements*, is published by the BMPR and sent to each district. The report presents a history of Interstate conditions and trends in IRI and rutting values. This information can be used in the rehabilitation planning process. Such information allows districts to track the effects of pavement rehabilitation projects on overall district ride quality, thereby ensuring smooth-riding pavements for the motoring public.

53-1.04(c) Faulting Data

A pavement fault is the difference in elevation across a longitudinal or transverse joint or crack. Although faulting can occur across longitudinal joints and cracks, transverse joints and cracks are more susceptible to faulting distress. Transverse faulting occurs when eroded or infiltrated materials build up under the approach side of the joint or crack and a corresponding depression occurs under the exit side. Water, heavy traffic, and poor load transfer across the joint or crack all contribute to pumping which results in pavement faulting. Faulting is primarily a jointed concrete pavement distress. Faulting can occur in continuously reinforced concrete pavements if the steel ruptures, but generally the steel prevents faulting. Faulting can also reflect through an overlaid jointed concrete pavement. The presence and degree of faulting can impact the rehabilitation selection process.

The automated (DCV) method is used to measure pavement faults. The fault measurements taken in the field are averaged over the length of the pavement section to rate the severity of the pavement faulting.

DCVs measure only transverse faults between 0.02 in and 1.5 in. If the change in elevation of the transverse fault is outside of this range, the DCV does not record the presence of the fault. Additionally, if a single fault is recorded over a length of pavement, average faulting is still reported for that pavement section. Because of the potential for inaccuracy and misrepresentation, faulting measurements obtained from DCVs should be reviewed in the field.

Reliable fault measurements can be taken by hand using a simple fault gauge available from the BMPR. Faulting severities are shown in Figure 53-1C. Jointed reinforced concrete pavements on the Interstate system with average faulting in excess of 0.5 in qualify for additional overlay thickness based on current Department policy. Pavement faults in excess of 0.75 in should be repaired.

FAULTING SEVERITY	AVERAGE FAULT DEPTH (D_f)
Low	$D_f < 0.2$ in
Medium	0.2 in $\leq D_f \leq$ 0.5 in
High	$D_f > 0.5$ in

DEFINITIONS FOR PAVEMENT FAULTING SEVERITY

Figure 53-1C

53-1.04(d) Data Sources

Rutting, roughness, and faulting data can be obtained from several sources in the Department. See Section 53-1.03 for addition information on data sources.

53-2 PAVEMENT DISTRESS TYPES

Pavement distresses may be indicative of two distinctly different types of failures:

1. Structural Failure. Structural failure is the loss of load carrying capacity of the pavement structure or a breakdown of one or more of the pavement's structural components or the underlying subgrade of such a magnitude as to make the pavement incapable of sustaining the traffic loads imposed upon its surface.

2. Surface (Functional) Failure. Surface, or functional, failure may or may not be accompanied by structural failure, but it is such that the pavement will not carry out its intended function without causing discomfort to passengers or without causing high stresses in the vehicle that passes over it due to pavement roughness.

It is important to clearly understand the distinction between these two types of failures when identifying and assessing distress types, the cause of failure, and developing rehabilitation strategies. Otherwise, a rehabilitation project may not adequately mitigate the pavement deficiency. Also, the distress types and severities listed below do not include the distress codes used in the CRS data. These codes may be obtained from OPP.

53-2.01 Diagnosing Structural and Surface Distresses

Identifying and assessing pavement distresses to determine whether or not the pavement is exhibiting a structural or functional failure is paramount. The degree of distress for both structural and surface failures is gradational, and the severity of distress is largely subjective. For example, consider a rigid pavement that has been resurfaced with an AC overlay. The surface may develop rough spots as a result of breakup in the bituminous overlay (i.e., functional failure) without structural breakdown of the underlying rigid structure. Conversely, the same pavement may crack and break up as a result of vehicular overload (i.e., structural failure). Rehabilitation measures for the first situation may consist of resurfacing to restore a smooth-riding surface. However, if the distress represents a structural failure, the entire pavement structure may require major or complete rehabilitation. Selecting the proper rehabilitation method depends on accurate diagnoses of the distress type to obtain a cost-effective rehabilitation. The cause of either of the above example distress conditions may be threefold:

- vehicular overload (e.g., excessive gross loads, high repetition of loads, high tire pressures) which can cause either structural or functional failure;

- climatic and environmental conditions which can cause surface irregularities and structural weakness (e.g., frost heaving, volume change in soil due to wetting and drying, breakup resulting from freezing and thawing, improper drainage); and

- disintegration of paving materials due to freezing and thawing and/or wetting and drying (e.g., "D" cracking, scaling of rigid pavements resulting from nondurable aggregates or ice-removal salts, breakdown of base course materials into fines causing an unstable mix to develop).

The rehabilitation of pavements in Illinois presents several challenges for the designer. It is essential that the designer be familiar with distress types, causes, and the means for their rehabilitation. While reviewing distresses on a section, the designer must consider the structural integrity of the existing section and select a rehabilitation strategy to address items such as inadequate structure for design traffic, original construction deficiencies, past maintenance, material durability, and geometric limitations.

53-2.02 Asphalt Concrete (AC) Pavement Distresses

This section applies to both AC pavements and rigid pavements that have been resurfaced with an AC overlay. The distresses that may be encountered include:

1. Alligator (Fatigue) Cracking. Alligator, or fatigue, cracking is a series of interconnecting cracks forming many-sided, sharp-edged pieces. The cracks develop a pattern resembling chicken wire or the skin of an alligator. The longest side of the pieces is usually less than 1 ft in length. Pattern-type cracking that occurs over an area not subjected to traffic load is rated as block cracking.

    a. Severity Levels:

        Low. Longitudinal disconnected hairline cracks running parallel to each other. The cracks are not spalled. Initially there may be only a single crack in the wheelpath.

        Medium. Further development of low severity fatigue cracking into a pattern of pieces formed by cracks that may be sealed.

        High. Medium fatigue cracking has progressed so that pieces are more severely spalled at the edges and may have loosened until the cells rock under traffic. Pumping may exist.

    b. Diagnosis. Usually indicates a structural failure in the pavement and can be related to poor subgrade support.

2. Bleeding. Asphalt bleeding is the presence of excess asphalt material on the pavement surface. It usually occurs in the wheelpaths. Asphalt material spilled onto the surface from sealing operations or moving vehicles should not be included.

    a. Severity Levels. Severity levels are not applicable to this distress type.

b. Diagnosis. By itself, this distress usually indicates a surface failure or material design problem. Excessive areas of bleeding may indicate the presence of stripping in the bituminous mixture.

3. Block Cracking. Block cracking, sometimes called area cracking, divides the asphalt surface into somewhat rectangular pieces. The blocks can range in size from approximately 1 ft^2 to 100 ft^2. Block cracking normally occurs over a large portion of the pavement area. The cracks usually extend only a short distance into the bituminous surface. Block cracking is age and environment related and should not be mistaken for alligator cracking, which is load related.

a. Severity Levels:

Low. Cracks are tight with a mean width 0.25 in or less. Minor or no spalling is present.

Medium. Crack width is between 0.25 in and 0.5 in. Cracks may be moderately spalled. Low severity random parallel cracking may exist near the crack or at the intersection of cracks.

High. One or more of the following conditions exist:

- crack width is greater than 0.5 in,
- crack is severely spalled, and/or
- medium or severe random parallel cracking exists near the crack or at the intersection of the cracks.

b. Diagnosis. By itself, this distress does not usually indicate a structural failure. It is considered a surface failure.

4. Edge Cracking. Crescent-shaped cracks or fairly continuous cracks that are parallel to and usually within 1 ft to 2 ft of the outer edge of the pavement and are usually load related.

a. Severity Levels:

Low. Cracks with no breakup or raveling.
Medium. Cracks with some breakup or raveling.
High. Cracks with considerable breakup or raveling along the edge.

b. Diagnosis. A low severity usually indicates a surface failure. However, a high severity level may indicate a structural failure.

5. Longitudinal Cracking. Longitudinal cracks are generally parallel to the centerline. They may appear anywhere between the centerline and the outer edge of the outer wheelpath. These cracks may be fairly straight or may meander within the lane width. This distress does not include centerline distress or widening distress.

   a. Severity Levels:

      Low. Cracks are tight with a mean width of 0.25 in or less. Minor or no spalling present.

      Medium. Crack width is between 0.25 in to 0.5 in. Cracks may be moderately spalled. Low severity random parallel cracks may exist near the crack or at the intersection of cracks.

      High. One or more of the following conditions exist:

      - crack width is greater than 0.25 in,
      - crack is severely spalled, and/or
      - medium or severe random parallel cracks exist near the crack or at the intersection of cracks.

   b. Diagnosis. A low severity level usually indicates a surface failure. However, a high severity level may indicate a structural failure.

6. Permanent Patch Deterioration. A patch is an area where a portion or all of the original pavement slab has been removed and replaced with a permanent type of material (e.g., PCC concrete or bituminous concrete). Only permanent patches should be considered.

   a. Severity Levels:

      Low. Any patch that is present. The patch has little or no deterioration. Cracks and edge joints are tight. Low severity distress may exist. No faulting or settlement has occurred. Patch is rated low severity even if it is in excellent condition.

      Medium. Patch is somewhat deteriorated. Settlement is less than 0.5 in. Cracking, rutting, or shoving has occurred in an asphalt patch. Concrete patch may exhibit spalling and/or faulting up to 0.5 in around the edges and/or cracks.

      High. Patch is badly deteriorated either by cracking, faulting, spalling, rutting, humping, or shoving to a condition which requires replacement. Patch may present tire damage potential.

b. Diagnosis. All severity levels may indicate a surface failure or an impending localized structural failure.

7. Potholes and Localized Distress. Potholes and localized distress are bowl-shaped holes of various sizes in the pavement surface. The bituminous material has broken into small pieces by fatigue cracking or by localized disintegration of the mixture and the material is removed by traffic. Base failures, poor drainage, and weak or thin bituminous concrete layers can contribute to the formation of potholes. This distress does not include reflective "D" cracking as identified by white fines or stains on the surface. Potholes or localized failures associated with cracks or joints are not recorded under this distress.

a. Severity Levels: Severity levels include:

DEPTH (d)	**AREA (A)**		
	$A < 1$ ft^2	**1 ft$^2 \leq A \leq 3$ ft^2**	**$A > 3$ ft^2**
$d < 1$ in	Low	Low	Medium
1 in $\leq d \leq$ 2 in	Medium	Medium	High
$d > 2$ in	Medium	High	High

Note: Potholes that have been partially filled by maintenance personnel should be rated the same as an unfilled pothole (i.e., a filled pothole 2 ft^2 with a remaining depth of 1.5 in would be rated as a medium severity level. If depth was 0.5 in, severity would be rated as a low severity level.

b. Diagnosis. A low severity may indicate either a surface failure or an impending localized structural failure. However, a high severity level usually indicates a localized structural failure. Numerous locations at any severity level indicate a material durability problem.

8. Pumping and Water Bleeding. Pumping is the ejection through cracks of water and fine materials under pressure that is generated by moving traffic loads. As the water is ejected, it carries with it fines from the underlying subgrade or pavement materials. This results in progressive deterioration and loss of support, especially in stabilized base materials. Surface staining or accumulation of fines on the surface close to cracks is evidence of pumping. Water bleeding occurs where water seeps slowly out of cracks in the pavement surface. If pumping or water bleeding exists anywhere on the pavement, it is noted as occurring.

a. Severity Levels:

Low. Water bleeding exists or water pumping can be observed when heavy vehicular loads pass over the pavement surface. However, no fines can be seen on the surface of the pavement.

Medium. A small amount of pumped material can be observed near cracks in the surface.

High. A significant amount of pumped material exists on the surface near the cracks.

b. Diagnosis. Water bleeding alone may indicate either a surface failure or an impending structural failure. Any level of pumping usually indicates a structural failure.

9. Raveling, Weathering, and Segregation. This distress group is the wearing away of the pavement surface caused by the dislodging of aggregate particles (raveling) and loss of asphalt binder (weathering). Segregation is the result of the coarse and fine components of the bituminous mix being unintentionally segregated during construction.

a. Severity Levels:

Low. Wearing away of the aggregate or binder has begun but has not progressed significantly.

Medium. Aggregate and/or binder has worn away. Surface texture is becoming rough and pitted. Loose particles generally exist.

High. Aggregate and/or binder has worn away. Surface texture is very rough and pitted.

b. Diagnosis. By itself, this distress usually indicates a surface failure. However, this distress group is often the starting point for subsequent localized structural failure.

10. Reflective Centerline Cracking. Reflective centerline cracking is located along the centerline of the existing surface of two-lane pavements and between lanes of pavements with three or more lanes. The joint formed by the bituminous paving operation is included in this distress.

a. Severity Levels:

Low. Cracks are tight with a mean width of 0.25 in or less. Minor or no spalling present.

Medium. Crack width is between 0.25 in and 0.5 in. Cracks may be moderately spalled. Low severity random parallel cracking may exist near the crack or at the intersection of cracks.

High. One or more of the following conditions exist:

- crack width is greater than 0.5 in,
- crack is severely spalled, and/or
- medium or severe random parallel cracking exists near the crack or at the intersection of cracks.

b. Diagnosis. Low severity usually indicates a surface failure. However, a high severity level may indicate a structural failure.

11. Reflective "D" Cracking. Series of interconnecting cracks in the wheelpath or at the outside edge of overlaid "D"-cracked concrete pavement. The surface has an alligator cracking pattern with the seeping of water and fine material from the underlying concrete. Typically, the area is depressed and tends to be found as a localized area of distress.

a. Severity Levels:

Low. Interconnecting cracks in small area (12 in diameter or less) with little or no fines evident.

Medium. Area of interconnecting cracks in an area of 12 in diameter or greater. Any area with a moderate amount of fines evident. Area may be depressed.

High. Any area with severe interconnecting cracking and loss of surface material or evidence of patching. Maintenance patching has been performed or is needed.

b. Diagnosis. Usually indicates a localized structural failure in the pavement.

12. Reflective Widening Cracking. Reflective widening cracking runs parallel to the pavement edge. This type of crack typically occurs 2 ft to 4 ft from the edge of both sides of the pavement and is very straight. In some cases, the crack may occur 6 ft to 8 ft from one edge of the pavement, indicating all of the widening was placed on one side.

a. Severity Levels:

Low. Cracks are tight with a mean width of 0.25 in or less. Minor or no spalling present.

Medium. Crack width is between 0.25 in and 0.5 in. Cracks may be moderately spalled. Low severity random parallel cracking may exist near the crack or at the intersection of cracks.

High. One or more of the following conditions exist:

- crack width is greater than 0.5 in,
- crack is severely spalled, and/or
- medium or severe random parallel cracking exists near the crack or at the intersection of cracks.

b. Diagnosis. A low severity usually indicates a surface failure. However, a high severity level may indicate a structural failure.

13. Rutting. A rut is a surface depression in the wheelpath. Pavement uplift may occur along the sides of the rut. Rutting may be a materials related problem or may be a result of traffic loading.

a. Severity Levels (Based on DCV Sensor Data):

Low. Ruts average less than 0.15 in deep.
Medium. Ruts average 0.15 in to 0.35 in deep.
High. Ruts average more than 0.35 in deep.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure of the bituminous mixture.

14. Shoving. Shoving is a longitudinal displacement of a localized area of the bituminous concrete surface. Shoving is generally caused by braking or accelerating vehicles at locations on hills, curves, and intersections. It also may have associated vertical displacement. Shoving is a form of plastic movement of the bituminous mixture.

a. Severity Levels. Severity levels are not applicable to this distress type.

b. Diagnosis. By itself, this distress usually indicates a surface failure. However, excessive displacement that is continuous usually indicates a structural failure of the bituminous mixture.

15. Transverse Cracking. Transverse cracks extend across the pavement more or less perpendicular to the centerline. These cracks are caused by the underlying pavement or stabilized base reflecting through the bituminous surface. The cracks also may be due to thermal cracking of the bituminous surface.

a. Severity Levels:

Low. Cracks are tight with a mean width of 0.25 in or less. Minor or no spalling present.

Medium. Crack width is between 0.25 in and 0.5 in. Cracks may be moderately spalled. Low severity random parallel cracking may exist near the crack or at the intersection of cracks.

High. The crack area may be depressed causing severe bump to a vehicle and/or one or more of the following conditions exist:

- crack width is greater than 0.5 in,
- crack is severely spalled, and/or
- medium or severe random parallel cracking exists near the crack or at the intersection of cracks.

16. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates extreme vertical movements or a structural failure.

53-2.03 Jointed Portland Cement Concrete (PCC) Pavement Distresses

The distresses that may be encountered on jointed Portland cement concrete pavements include:

1. Blowups. Most blowups occur during spring and hot summer at transverse joints or wide cracks. Rain or wet pavement just prior to a hot period is closely related to blowups. Infiltration of incompressible materials into joints or cracks during cold periods results in high compressive stresses during hot periods. Where this compressive pressure becomes too great, a localized upward movement or shattering of the slab occurs at the joint or crack. Blowups are accelerated due to spalling of material from the slab bottom which creates a reduced joint contact area. The presence of “D” cracking or freeze-thaw damage weakens the concrete near the joint which further increases spalling and blowup potential.

   a. Severity Levels:

   Low. Blowup has occurred, but only causes some bounce of the vehicle which creates no discomfort.

   Medium. Blowup causes a significant bounce of the vehicle which creates some discomfort. Temporary patching may have been placed because of the blowup.

High. Blowup causes excessive bounce of the vehicle which creates substantial discomfort, and/or a safety hazard, and/or vehicle damage requiring a reduction in speed for safety. High severity blowups require immediate maintenance due to the safety hazard.

b. Diagnosis. All severity levels indicate an impending structural failure.

2. Corner Breaks. A corner break is a crack that intersects the joints at a distance less than 6 ft on each side measured from the corner of the slab. A corner break extends vertically through the entire slab thickness. Load repetition combined with loss of support, poor load transfer across joint, and thermal curling and moisture warping stresses usually cause corner breaks.

a. Severity Levels:

Low. Crack is tight (hairline). Well-sealed cracks will be considered tight. No faulting or break-up at broken corner exists. Crack is not spalled.

Medium. Crack is working and spalled at low or medium severity. Break-up of broken corner has not occurred. Faulting of crack or joint is less than 0.5 in. Temporary patching may have been placed because of corner break.

High. Crack is spalled at high severity or the corner piece has broken into two or more pieces. If faulting of crack or joint is more than 0.5 in, it will be considered high severity.

b. Diagnosis. A low severity indicates an impending structural failure. However, a high severity level usually indicates a structural failure.

3. "D" Cracking. "D" cracking is a series of closely spaced hairline cracks that usually begins on the PCC pavement slab surface adjacent to transverse and longitudinal joints and cracks and at the free edge of jointed pavements. The surface cracks often appear as a darker stained area and may contain a white residue which leaches from the cracks. Staining alone does not indicate the presence of "D" cracking. "D" cracking is the expansion of susceptible coarse aggregate by the wetting, drying, freezing, and thawing cycles imposed by the Illinois climate.

a. Severity Levels:

Low. The characteristic crack pattern is evident along with staining and leaching. A fan shape spreading of the cracks is also evident. No spalling is present.

Medium. The characteristic crack pattern is very evident and patterns at individual transverse cracks are beginning to join together. Minor spalling is evident and the pavement may produce a hollow sound when thumped. Little or no maintenance patching exists.

High. A high level of spalling is evident and the pavement may produce a hollow sound when thumped. Patching has been performed or is necessary. Considerable loose material exists along the shoulders. A crack pattern is formed between several adjacent transverse cracks.

b. Diagnosis. Indicates a material durability problem and usually indicates a structural failure in the pavement.

4. High Steel Spalling. This distress is the spalling of the concrete surface that results from the placement during construction of the reinforcing steel too high in the cross section of the pavement (i.e., too near to the surface). Usually, the reinforcing steel itself is visible and localized surface distress exists (i.e., an area of slab surface where the concrete has broken into pieces and spalled).

a. Severity Levels:

Low. Spalling is less than 12 in in diameter or length.
Medium. Spalling is 12 in to 18 in in diameter or length.
High. Spalling is over 18 in in diameter or length.

b. Diagnosis. By itself, this distress usually indicates a surface failure. However, high severity levels, left unattended, may result in a reduced cross section and rupture of reinforcing steel which may cause localized structural failures.

5. Joint/Crack Faulting. Faulting is the difference in elevation across a joint or crack. Faulting is caused in part by the buildup of loose materials under the approach slab near the joint or crack as well as depression of the exit slab. The buildup of eroded or infiltrated materials is caused by pumping from under the exit slab and shoulder (free moisture under pressure) due to heavy traffic loadings. The warp and/or curl upward of the slab near the joint due to moisture and/or temperature gradient contributes to the pumping condition. Lack of load transfer contributes greatly to faulting.

a. Severity Levels:

Low. Average faulting is 0.2 in or less.
Medium. Average faulting is between 0.2 in and 0.5 in.
High. Average faulting is greater than 0.5 in.

b. Diagnosis. Any severity level indicates an impending structural failure.

6. Joint/Crack Spalling. Cracking, breaking, chipping, or fraying of slab edges within 2 ft of transverse joints or cracks.

a. Severity Levels:

Low. Spalls less than 3 in wide, measured to the center of the joint/crack, with loss of material, or spalls with no loss of material and no patching.

Medium. Spalls 3 in to 6 in wide, measured to the center of the joint/crack, with loss of material.

High. Spalls greater than 6 in wide, measured to the center of the joint/crack, with loss of material.

b. Diagnosis. By itself, indicates high compressive forces or incompressible material in joint/crack. At high levels, this distress usually indicates a surface failure.

7. Joint Deterioration. Joint deterioration is the cracking, widening, or faulting of the concrete at a joint.

a. Severity Levels:

Low. Tight hairline cracking around joints with no spalling or faulting.

Medium. The joint has opened to a width less than 1 in or has 0.25 in faulting or spalling. The area between the crack and joint has begun to break up but is not dislodged.

High. The joint has opened to a width of greater than 1 in or has a high level (0.5 in) of faulting or spalling. The area between the crack and the joint has broken up and pieces are dislodged to the point that tire damage may occur.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

8. Longitudinal Cracking. Longitudinal cracks generally occur parallel to the centerline of the pavement but may meander throughout the lane. This does not include centerline distress. They may be the result of concrete shrinkage, warping stresses, improper sawing, or loss of support.

a. Severity Levels:

Low. Tight hairline crack with no spalling or faulting or a well sealed crack with no visible faulting or spalling. Does not include “Y” or interconnecting cracks.

Medium. Working crack with a moderate or low severity of spalling and/or faulting less than 0.5 in. Includes "Y" and interconnecting cracks with no punchouts or material loss.

High. A crack which exhibits one or more of the following:

- width greater than 1 in,
- high severity level or spalling, and/or
- faulting of 0.5 in or more.

High severity includes "Y" and interconnecting cracks with punchouts or material loss. Maintenance patching is present or is needed.

b. Diagnosis. A low severity may indicate an impending structural failure. However, a high severity level usually indicates a structural failure.

9. Map Cracking and Scaling. Map cracking, or crazing, is a network of shallow hairline cracks which extend only through the upper surface of the concrete. It is usually caused by over-finishing the concrete surface. Care must be taken to avoid confusing this distress with "D" cracking. Map cracking usually does not exhibit the staining or leaching associated with "D" cracking nor is a hollow sound produced by thumping the pavement. Scaling is the removal of the thin top surface of the concrete usually associated with map cracking.

a. Severity Levels. Severity levels are not applicable to this distress type.
b. Diagnosis. By itself, this distress usually indicates a surface failure.

10. Permanent Patch Deterioration. A patch is an area where a portion or all of the original concrete slab has been removed and replaced with a permanent type of material (e.g., PCC concrete or bituminous concrete). Only permanent patches should be considered. Deterioration of the original concrete slab adjacent to the permanent patch is termed patch adjacent slab deterioration. This may be in the form of spalling of the slab/patch joint, "D" cracking of the slab adjacent to the patch, or a corner break in the adjacent slab. Distress which begins more than 6 ft from the patch is not included in patch adjacent slab deterioration.

a. Severity Levels:

Low. Any patch that is present. Patch has little or no deterioration. Cracks and edge joints are tight. Low severity spalling or raveling may exist. No faulting or settlement has occurred. Patch is rated low severity even if in excellent condition.

Medium. Patch is somewhat deteriorated. Settlement is less than 0.5 in. Cracking, rutting, or shoving has occurred in an asphalt patch. Concrete patch may exhibit spalling and/or faulting up to 0.5 in around the edges of cracks.

High. Patch is badly deteriorated either by cracking, faulting, spalling, rutting, or shoving to a condition that requires replacement. Patch may present tire damage potential.

b. Diagnosis. A low severity usually indicates a surface failure. However, a high severity level may be either a progressively deteriorated surface condition or an impending localized structural failure.

11. Polished Aggregate. This distress is the wearing away of the surface texture such that a loss of skid resistance can result.

a. Severity Levels. Severity levels are not applicable to this distress type.
b. Diagnosis. By itself, this distress usually indicates a surface failure.

12. Pumping and Water Bleeding. Pumping is the ejection of material by water through joints or cracks, caused by deflection of the slab under moving traffic loads. As the water is ejected, it carries with it particles of gravel, sand, clay, or silt resulting in a progressive loss of pavement support. Surface staining or accumulation of base or subgrade material on the pavement surface close to joints or cracks is evidence of pumping. However, pumping can occur without such evidence, particularly where stabilized bases are used. The observation of water being ejected by heavy traffic loads after a rainstorm can also be used to identify pumping. Water bleeding occurs where water seeps out of joints or cracks.

a. Severity Levels:

Low. Water is forced out of a joint or crack when trucks pass over the joints or cracks; water is forced out of the lane/shoulder joint when trucks pass along the joint; or water bleeding exists. No fines can be seen on the surface of the traffic lanes or shoulder.

Medium. A small amount of pumped material can be observed near some of the joints or cracks on the surface of the traffic lane or shoulder.

High. A significant amount of pumped materials exist on the pavement surface of the traffic lane or shoulder along the joints or cracks.

b. Diagnosis. Water bleeding alone may indicate either a surface failure or an impending structural failure. Any level of pumping usually indicates a structural failure.

13. Transverse Cracking. Transverse cracking of jointed reinforced slabs is a normal occurrence and is caused by one or more of the following:

- heavy vehicular load repetition,
- thermal and moisture gradient stresses,
- drying shrinkage stresses,
- loss of subgrade support, and/or
- non-functioning contraction joints.

a. Severity Levels:

Low. Tight hairline cracks with no spalling or faulting or a well sealed crack with no visible faulting or spalling.

Medium. Working crack with low to medium severity level of spalling and/or faulting less than 0.5 in. Temporary patching may be present.

High. A crack that exhibits one or more of the following:

- width greater than 1 in,
- high severity level of spalling, and/or
- faulting of 0.5 in or more.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

14. Transverse Joint Seal Damage. The following applies to jointed concrete pavements constructed prior to 2003. Existing preformed joint seals should be evaluated as they do not meet current design dimensions and do require sealing to perform. Joint seal damage is any condition that enables incompressible materials to infiltrate into the joints from the surface or allows significant infiltration of water. Accumulation of incompressible materials within the joints restricts in-slab expansion and may result in the slab buckling, shattering, or spalling. A pliable joint filler that is bonded to the edges of the slabs protects the joints from accumulation of incompressible materials and also reduces the amount of water seeping into the pavement structure. Transverse joint seal damage is rated based on the overall condition of the sealant over the entire pavement section. Typical types of joint seal damage are:

- stripping of joint sealant,
- extrusion of joint sealant,
- weed growth,
- hardening of the filler (oxidation),
- loss of bond to the slab edges, and
- lack or absence of sealant in the joint.

a. Severity Levels:

Low. Joint sealer is in generally good condition throughout the section. Sealant is performing well with only a minor amount of any of the above types of damage present. Little water and no incompressible materials can infiltrate through the joint.

Medium. Joint sealer is in generally fair condition over the entire section with one or more of the above types of damage occurring to a moderate degree. Water can infiltrate the joint fairly easily; some incompressible materials can infiltrate the joint. Sealant needs replacement within 3 years.

High. Joint sealer is in generally poor condition over the entire section with one or more of the above types of damage occurring to a severe degree. Water and incompressible materials can freely infiltrate the joint. Sealant needs immediate replacement.

b. Diagnosis. By itself, this distress usually indicates a failure of the joint material. Prolonged inattention to the problem can lead to surface or even structural failures.

53-2.04 Continuously Reinforced Concrete (CRC) Pavement Distresses

The distresses that may be encountered on continuously reinforced concrete pavements include:

1. Blowups. Blowups are caused by a combination of thermal and moisture expansive forces which exceed the pavement system's ability to absorb in conjunction with a pavement discontinuity. Blowups occur at construction joints or at wide transverse cracks at which the steel has previously ruptured. The result is a localized upward movement (buckling) of the slab at the edges of the crack or construction joint accompanied by shattering of the concrete or crushing of the slab in that area. Rain or wet pavement just prior to a hot period is closely related to blowups.

   a. Severity Levels:

   Low. Buckling or shattering has occurred, but only causes some bounce of the vehicle which creates no discomfort.

   Medium. Buckling or shattering causes a significant bounce of the vehicle which creates some discomfort. Temporary patching has been placed because of a blowup.

High. Buckling or shattering causes excessive bounce of the vehicle which creates substantial discomfort, and/or a safety hazard, and/or vehicle damage, requiring a reduction in speed for safety. High severity blowups require immediate maintenance due to the safety hazard.

b. Diagnosis. All severity levels may indicate an impending structural failure.

2. Centerline Joint Spalling. Cracking, breaking, chipping, or fraying of slab edges within 2 ft of the centerline (lane-to-lane) joint.

a. Severity Levels:

Low. Spalls less than 3 in wide, measured to the center of the joint, with loss of material, or spalls with no loss of material and no patching.

Medium. Spalls 3 in to 6 in wide, measured to the center of the joint, with loss of material.

High. Spalls greater than 6 in wide, measured to the center of the joint, with loss of material.

b. Diagnosis. By itself, this distress usually indicates a surface failure.

3. Closed Expansion Joints. Existing CRCP expansion joints which have become closed can result in other failures such as spalling, cracking, or blowups in the pavement.

a. Severity Levels. Severity levels are not applicable to this distress type.

b. Diagnosis. If other distresses are allowed to occur and increase in severity, structural integrity of the pavement may be compromised.

4. Construction Joint Deterioration. Construction joint distress is a breakdown of the concrete or steel at a CRCP construction joint. It often results in a series of closely spaced transverse cracks near the construction joint or a large number of interconnecting cracks. These excessive cracks can, in time, lead to spalling and breakup of the concrete. If an inadequate steel lap or a steel rupture occurs at a construction joint, the result is often spalling and disintegration of the surrounding concrete, and a possible punchout. This can also lead to a readily accessible entrance for water. The primary causes of construction joint distress are poorly consolidated concrete and inadequate steel content or placement.

a. Severity Levels:

Low. Only closely spaced tight cracks with no spalling or faulting occur within 10 ft of each side of the construction joint.

Medium. Some low severity spalling of cracks, or a low severity punchout exists within 10 ft of either side of the construction joint. Temporary patching has been placed.

High. Significant deterioration and breakup exists within 10 ft of the construction joint that requires patching.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

5. "D" Cracking. "D" cracking is a series of closely spaced hairline cracks that usually begins on the PCC slab surface adjacent to transverse construction joints, longitudinal joints/cracks, the normal tight transverse cracking pattern, and pavement edge in CRC pavements. The surface cracks often appear as a darker stained area and may contain a white residue which leaches from the cracks. Staining alone does not indicate the presence of "D" cracking. "D" cracking is the expansion of susceptible coarse aggregate caused by the wetting, drying, freezing, and thawing cycles imposed by the Illinois climate.

a. Severity Levels:

Low. The characteristic crack pattern is evident along with staining and leaching. A fan shape spreading of the cracks is also evident. No spalling is present.

Medium. The characteristic crack pattern is very evident and patterns at individual transverse cracks are beginning to join together. Minor spalling is evident and the pavement may produce a hollow sound when thumped. Little or no maintenance patching exists.

High. A high level of spalling is evident and the pavement may produce a hollow sound when thumped. Patching has been performed or is necessary. Considerable loose material exists along the shoulders. A crack pattern is formed between several adjacent transverse cracks.

b. Diagnosis. Indicates a materials durability problem and usually indicates a structural failure in the pavement.

6. High Steel Spalling. This distress is the spalling of the concrete surface that results from the placement during construction of the reinforcing steel too high in the cross section of the pavement (i.e., too near to the surface). Usually, the reinforcing steel itself is visible and localized surface distress exists (i.e., an area of slab surface where the concrete has broken into pieces and spalled).

a. Severity Levels:

Low. Spalling is less than 12 in in diameter or length.
Medium. Spalling is 12 to 18 in in diameter or length.
High. Spalling is over 18 in in diameter or length.

b. Diagnosis. By itself, this distress usually indicates a surface failure. However, high severity levels, left unattended, may result in a reduced cross section and rupture of reinforcing steel which will cause a localized structural failure.

7. Longitudinal Cracking. Longitudinal cracks generally occur parallel to the centerline of the pavement but may meander throughout the lane. This distress type does not included centerline distress.

a. Severity Levels:

Low. Tight hairline crack with no spalling or faulting, or a well sealed crack with no visible faulting or spalling. Does not include “Y” or interconnecting cracks.

Medium. Working crack with a moderate or low severity of spalling and/or faulting less than 0.5 in. Includes “Y” and interconnecting cracks with no punchouts or material loss.

High. A crack which exhibits one or more of the following:

- width greater than 1 in,
- a high severity level of spalling, and/or
- faulting of 0.5 in or more.

High severity includes “Y” and interconnecting cracks with punchouts or material loss. Maintenance patching may be present or is needed.

b. Diagnosis. A low severity may indicate an impending structural failure. However, a high severity level usually indicates a structural failure.

8. Map Cracking and Scaling. Map cracking, or crazing, is a network of shallow hairline cracks which extend only through the upper surface of the concrete. It is usually caused by over-finishing the concrete surface. Care must be taken to avoid confusing this distress with “D” cracking. Map cracking usually does not exhibit the staining or leaching associated with “D” cracking nor is the hollow sound produced by thumping the pavement. Scaling is the removal of the thin top surface of the concrete usually associated with map cracking.

a. Severity Levels. Severity levels are not applicable to this distress type.
b. Diagnosis. By itself, this distress usually indicates a surface failure.

9. Permanent Patch Deterioration. A patch is an area where a portion or all of the original concrete slab has been removed and replaced with a permanent type of material (e.g., PCC concrete, bituminous concrete). Only permanent patches should be considered. Deterioration of the original concrete slab adjacent to the permanent patch is termed patch adjacent slab deterioration. This may be in the form of spalling of the slab/patch joint or "D" cracking of the slab adjacent to the patch. Distress which begins more than 6 ft from the patch is not included in patch adjacent slab deterioration.

   a. Severity Levels:

      Low. Any patch that is present. Patch has little or no deterioration. Cracks and edge joints are tight. Low severity spalling or raveling may exist. No faulting or settlement has occurred. Patch is rated low severity even if in excellent condition.

      Medium. Patch is somewhat deteriorated. Settlement is less than 0.5 in. Cracking, rutting, or shoving has occurred in an asphalt patch. Concrete patch may exhibit spalling and/or faulting up to 0.5 in around the edges of cracks.

      High. Patch is badly deteriorated either by cracking, faulting, spalling, rutting, or shoving to a condition that requires replacement. Patch may present tire damage potential.

   b. Diagnosis. A medium severity usually indicates a surface failure. However, a high severity level may be either a progressively deteriorated surface condition or an impending localized structural failure.

10. Polished Aggregate. This distress is the wearing away of the surface texture such that a loss of skid resistance can result.

   a. Severity Levels. Severity levels are not applicable to this distress type.
   b. Diagnosis. By itself, this distress usually indicates a surface failure.

11. Pumping and Water Bleeding. Pumping is the ejection of material by water through joints or cracks, caused by deflection of the slab under moving traffic loads. As the water is ejected, it carries with it particles of gravel, sand, clay, or silt resulting in a progressive loss of pavement support. Surface staining or accumulation of base or subgrade material on the pavement surface close to joints or cracks is evidence of pumping. However, pumping can occur without such evidence, particularly where stabilized bases are used. The observation of water being ejected by heavy traffic loads after a rainstorm can also be used to identify pumping. Water bleeding occurs where water seeps out of joints or cracks.

a. Severity Levels:

Low. Water is forced out of a joint or crack when trucks pass over the joints or cracks; water is forced out of the lane/shoulder joint when trucks pass along the joint; or water bleeding exists. No fines can be seen on the surface of the traffic lanes or shoulder. There is evidence of the lane/shoulder joint being worn away be high pressure water.

Medium. A small amount of pumped material can be observed near some of the joints or cracks on the surface of the traffic lane or shoulder.

High. A significant amount of pumped materials exist on the pavement surface of the traffic lane or shoulder along the joints or cracks.

b. Diagnosis. Water bleeding alone may indicate either a surface failure or an impending structural failure. Any level of pumping usually indicates a structural failure.

12. Punchouts. Punchouts are the primary structural failure mode for CRS pavements. This distress is the area enclosed by two closely spaced transverse cracks, and a short longitudinal crack, typically at the edge of the pavement, but can occur elsewhere in the pavement. As cracks deteriorate, aggregate interlock is lost, leading to steel rupture which allows the concrete within these cracks to be punched downward under load. Localized area of the slab has broken or spalled.

a. Severity Levels:

Low. Longitudinal and transverse cracks are fairly tight. Low severity spalling or faulting less than 0.25 in exists.

Medium. Moderate spalling or faulting 0.25 in to 0.5 in exists. Cracks interconnect.

High. Concrete within the area is punched down by more than 0.5 in; and/or severely spalled or broken. Temporary patching is present or is required.

b. Diagnosis. Usually indicates a structural failure in the pavement.

13. Transverse Cracking. Transverse cracking of continuously reinforced slabs is a normal occurrence and is not in itself considered to be a distress. The purpose of the steel reinforcement is to hold the randomly spaced transverse cracks tightly together. However, if the steel ruptures or shears, load transfer across the crack is lost and the crack becomes a potential location for major distress. Crack spalling or faulting are an indication of sheared reinforcing bars. Some cracks may have widened substantially after steel rupture. Note that transverse cracks sometimes run diagonally across the pavement and intersect (“Y” cracks).

a. Severity Levels:

Low. Tight hairline cracks with no faulting, steel rupture, or spalling.

Medium. The crack is open, but less than 0.5 in with no steel rupture, faulting is 0.2 in or less and/or low severity spalling.

High. A crack with steel rupture, or medium to high severity spalling or crack width greater than 0.5 in.

b. Diagnosis. A medium severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

14. Wide Flange Beam Terminal Joint Distress. Wide flange beam terminal joint distress may prevent the joint from working properly both at the beam and at the expansion joint between the beam and the bridge approach. The flange of the beam may show signs of fatigue cracking.

a. Severity Levels. Severity levels are not applicable to this distress type.

b. Diagnosis. Structural integrity is being lost if the pavement area near these joints or if the beam itself show signs of distress and special patching may be required. Contact the BDE for assistance in determining a remedial treatment.

53-2.05 Shoulder Distresses

Shoulder distresses typically encountered on highway facilities include:

1. Alligator (Fatigue) Cracking. Cracking of the shoulder surface caused by repeated traffic loadings. The individual pieces of material are usually less than 1 ft on the longest side.

a. Severity Levels:

Low. Longitudinal tight cracks running parallel to each other. The cracks are not spalled.

Medium. The cracks are interconnected in the classic pattern with some spalling and a few loose pieces.

High. The cracks are interconnected forming small pieces which are easily removed. Evidence of base failures are evident and accompanied by rutting.

b. Diagnosis. Usually indicates a structural failure.

2. Block Cracking. Block cracks divide the shoulder surface into approximately rectangular pieces with the blocks ranging in size from 1 ft^2 to 100 ft^2.

   a. Severity Levels:

      Low. The blocks are outlined by tight cracks 0.25 in or less in width with little or no spalling.

      Medium. The blocks are outlined by cracks greater than 0.25 in in width with moderate spalling.

      High. Blocks are outlined by severely spalled cracks and base failures are evident.

   b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

3. Bridge Approach Pavement/Shoulder Settlement. Existing bridge approaches that were not initially constructed to current IDOT standards frequently exhibit settlement (i.e., a drop in elevation of the approach pavement and/or shoulder surface below the surface of the bridge deck). The cause of this distress usually is the settlement of the backfill material due to voids that exist beneath the bridge approach pavement and/or shoulder.

   a. Severity Levels:

      Low. Settlement is less than 2 in. Drainage is not a problem. Voids are not found beneath the bridge approach. The area is no longer continuing to settle.

      Medium. Settlement is approximately 2 in and/or drainage is a concern. Voids are found beneath the bridge approach and the approach area is likely to continue to settle.

      High. Settlement is more than 2 in and/or drainage is a significant problem. Voids are found beneath the bridge approach and the approach area is likely to continue to settle.

   b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

4. Lane/Shoulder Dropoff. Lane-to-shoulder dropoff occurs wherever there is a difference in elevation between the traffic lane and shoulder. Typically, the outside shoulder settles due to consolidation or settlement of the underlying granular or subgrade material, or pumping of the underlying material. Shoulder heave may occur due to frost action or

swelling soils. Granular or soil shoulder dropoff generally is caused from the removal of shoulder material from passing trucks (i.e., wind action).

a. Severity Levels:

Low. There exists between 0.5 in to 1 in difference in elevation between the traffic lane and adjacent shoulder.

Medium. There exists between 1 in to 2 in difference in elevation between the traffic lane and adjacent shoulder.

High. There exists greater than a 2 in difference in elevation between the traffic lane and adjacent shoulder.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure and a potential safety problem.

5. Lane/Shoulder Joint Spalling. Cracking, breaking, chipping, or fraying of shoulder edges within 1 ft to 2 ft of tied shoulder.

a. Severity Levels:

Low. Cracking and/or spalling less than 3 in wide.
Medium. Cracking and/or spalling 3 in to 6 in wide.
High. Cracking and/or spalling greater than 6 in wide.

b. Diagnosis. By itself, this distress usually indicates a surface failure.

6. Lane/Shoulder Separation. Lane-to-shoulder joint separation is the widening of the joint between the edge of the pavement and the shoulder. It will occur as a reflective crack on AC surfaces. As this joint deteriorates, it allows water to seep into the pavement structure and creates a maintenance problem to fill spalled areas. The widening of the joint between the traffic lane and shoulder is due generally to movement in the shoulder. If the joint is tightly closed or well sealed so water cannot enter, then lane-to-shoulder joint separation is not considered a distress. If the shoulder is not paved (i.e., gravel or soil), then the severity is usually rated high. If curbing exists, then it is rated according to the width of the joint between the pavement and curb.

a. Severity Levels:

Low. Joints/cracks having either minor spalling or a separation of 0.5 in to 1 in.

Medium. Joints/cracks that are moderately spalled or have a separation of 1 in to 2 in. Several parallel narrow cracks that are beginning to join together also would be classified as medium severity.

High. Cracks that are severely spalled or have a separation greater than 2 in. Evidence of a continual need for maintenance patching exists.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

7. Transverse Cracking. Transverse cracking is a distress in which the shoulder is cracked transversely at regular intervals. Frequently, grass and weeds are observed growing through the cracks.

a. Severity Levels:

Low. The cracks are tight with no vegetation growing through. Crack spacing is greater than 100 ft apart.

Medium. Cracks are greater than 0.25 in in width with some vegetation growing through. Crack spacing is between 50 ft and 100 ft.

High. Cracks are very open with a great deal of vegetation growing through. Crack spacing is less then 50 ft.

b. Diagnosis. A low severity may indicate either a surface failure or an impending structural failure. However, a high severity level usually indicates a structural failure.

For additional information on pavement distresses, see the Department's *Manual for Condition Rating Survey* and the Strategic Highway Research Program's *Distress Identification Manual*.

53-3 FIELD TESTING OF PAVEMENT STRUCTURES

53-3.01 Non-Destructive vs. Destructive Testing

In general, field testing methods can be categorized as follows:

1. Non-Destructive Testing (NDT) Methods. NDT methods provide information about the pavement structure with minimal disruption to traffic operations and without the need to physically disturb the pavement. In this regard, NDT methods are preferred over destructive testing methods. NDT methods include research of historical data, collection of data through field observations, falling weight deflectometer testing, pavement friction testing, and dynamic cone penetrometer testing. Coring is necessary for dynamic cone penetrometer testing under existing pavements. Because of the significant advantages of NDT over destructive testing methods, the designer should continually keep abreast of changes in the field of NDT.

2. Destructive Testing (DT) Methods. DT methods require the physical removal (and subsequent repair) of pavement layer material either to obtain a sample (disturbed or undisturbed) or to conduct an in-place test. DT methods include pavement slab removal, pavement slicing, and pavement coring. Although DT methods provide very reliable information on the in-place pavement structure, such testing has many disadvantages and limitations, particularly when conducted on moderately to heavily traveled highway facilities. Practical restraints in terms of time and money severely limit the number and type of DT methods that can be conducted for routine rehabilitation studies.

53-3.01(a) Major Parameters of Pavement Testing

The designer must accumulate sufficient information on the in-place condition of the pavement structure to determine the precise nature and cause of the pavement distress. The parameters of actual data collection will vary from project to project. For example, if a flexible pavement is experiencing low to medium rutting, less than 0.30 in, the rehabilitation required probably is routine and minimal field sampling and testing programs should be considered. Conversely, a flexible pavement may exhibit extensive rutting, greater than 0.30 in. Such rutting may be the result of many factors including material densification (improper compaction), deformation in the foundation (subgrade), and instability in the bituminous concrete mixture. Extensive field testing and data collection may be necessary to pinpoint the exact cause of the distress and to determine an appropriate rehabilitation strategy. Prepare the field sampling and testing program for the rehabilitation study before the scoping stage of Phase I. Field tests typically are requested during the project scoping stage.

The designer is responsible for determining the scope of the data collection process, including field sampling and testing, for the rehabilitation project and for minimizing the cost of the process by avoiding the collection of duplicate or superfluous information. There are, however, several major data parameters that should be considered for any major rehabilitation project. They are as follows:

- pavement deflection response,
- *in situ* pavement material characteristics (modulus, strength, density, stripping),
- pavement layer thickness, and
- type of pavement layer material.

When conducting the rehabilitation study, ensure that these parameters are adequately addressed during the data collection, field sampling, and testing program.

53-3.01(b) Need for Destructive Testing

Although NDT methods have significant advantages over DT methods, there will exist circumstances under which DT methods will be appropriate to include in the field sampling and testing program of the rehabilitation study. Consider the following when assessing the need for destructive testing:

1. *In Situ* Pavement Material Characteristics. NDT methods are preferred over DT methods for obtaining information on *in situ* pavement material characteristics. However, historic data also may be used with the caveat that *in situ* pavement material conditions may have changed since the now historic data was collected. Consider the need to conduct destructive tests to verify the pavement material properties which have been obtained by NDT methods. DT methods also may be used to determine underlying drainage conditions and to identify problems in specific layers of the pavement structure.

2. Rigid Pavements. For rigid pavements, one of the more significant material properties influencing performance is the flexural strength of the concrete (i.e. modulus of rupture). General correlations between splitting tensile strength and flexural strength can be obtained from DT methods (e.g., pavement cores).

3. Pavement Layer Thickness and Material Type. It is difficult to use NDT methods to accurately determine pavement layer thickness and material type. Layer thickness and material type usually can be identified from historic pavement information. Although historic pavement data may be available, the extreme importance and sensitivity of these variables usually necessitates the use of some level of DT for verification. At a minimum, pavement coring at randomly selected locations should be considered.

Although NDT methods are largely preferred over DT methods, a technically sound program of data collection, field sampling, and testing for pavement rehabilitation projects should include an appropriate level of complementary DT to ensure data integrity. Doing so will ensure that the rehabilitation alternatives developed will not be based on an inaccurate base of information. This is especially true of structural type distresses where improper rehabilitation treatments can waste resources.

53-3.02 Pavement Database Systems and Field Observations — NDT

53-3.02(a) Application of Pavement Database Systems

A review of information that may be available on the pavement section under study is an important initial step in the data collection process of any rehabilitation project. Assessing the applicability of available information will minimize the collecting of duplicate data. See Section 53-1 for information on the types of pavement data that are collected and maintained by the Department.

53-3.02(b) Supplemental Field Observations

The extent of the data collection activities required for a rehabilitation study will vary on a project-by-project basis. A field reconnaissance to verify historic data is invaluable for any rehabilitation study. Such supplemental field trips will allow first-hand observation of pavement distress including pumping, loose materials on shoulder, “D” cracking, and maintenance patches. This first-hand experience is extremely helpful in identifying and verifying pavement distresses and determining whether or not the pavement is exhibiting a surface failure or an existing or potential structural failure. Use these observations to better define the level of field sampling and testing to be conducted for the project.

53-3.03 Falling Weight Deflectometer (FWD) — NDT

53-3.03(a) FWD System

The FWD test is an NDT method. It is the only non-destructive pavement loading device capable of exerting a load impulse similar in magnitude and duration to a moving truck wheel load. The FWD unit can produce loads from 1500 lbs to 25,000 lbs. The load is applied to the loading plate by dropping a weight package on a dampening system. The load is measured by a load cell. The resulting pavement deflection is measured by five seismic deflection sensors positioned along the pavement’s surface at pre-determined intervals from the loading plate.

53-3.03(b) FWD System Application

One of the most frequent uses of the FWD system is in determining the required overlay thickness for existing flexible pavements. The FWD test data will provide information on the condition of the existing pavement and the level of subgrade support. The uniformity of support along the pavement can be assessed, and weak areas requiring additional overlay thickness can be identified. With the FWD test data, traffic data, the design load, and the desired design period, the designer can determine an appropriate overlay thickness. Designs are possible for a variety of pavement types including granular bases topped with a seal coat and full-depth asphalt concrete pavements.

53-3.03(c) Application of FWD Test Data

The FWD test has numerous applications for the analysis and design of pavement rehabilitation strategies and will help to develop cost-effective maintenance and rehabilitation alternatives.

The FWD test data can be used for the following pavement analyses:

1. PCC Pavements. For PCC pavements, the FWD test data can be used to:

    - locate areas of poor support beneath jointed concrete pavements, and
    - determine joint load transfer.

2. AC Pavements. For AC pavements, the FWD test data can be used to:

    - determine the structural adequacy of the pavement and identify causes of failure,
    - determine uniformity of support along a pavement and identify areas of weakness, and
    - determine overlay thickness requirements.

53-3.03(d) Test Requests

The BMPR is available to conduct a limited amount of testing. If FWD testing and analyses are desired, contact the Engineer of Pavement Technology in the BMPR.

53-3.04 Pavement Friction Testing (PFT) — NDT

53-3.04(a) PFT System

In the PFT system, a treaded tire makes a measurement of the microtexture of the pavement. Microtexture is that quality of aggregates that makes each particle feel rough or smooth to the touch. The rough surfaces penetrate the water film, permitting contact between the tire and the roadway. A smooth tire makes a measurement of the macrotexture of the pavement. Macrotexture is the frictional characteristic that provides escape paths for water between the tire and the pavement. Both macrotexture and microtexture are needed to make a frictionally adequate pavement.

53-3.04(b) PFT System Application

The PFT system is used to obtain smooth and trended friction numbers for the pavement section under study. The friction numbers represent the frictional properties of the pavement surface. They are used to evaluate the skid resistance of the pavement surface relative to other pavement surfaces and/or to evaluate the change in skid resistance of the pavement surface with time.

53-3.04(c) Application of PFT Test Data

The friction numbers obtained from the PFT system are used to:

- evaluate pavement mixture design practice,
- provide continued evaluation of experimental projects,
- evaluate pavement friction of high accident locations under wet pavement conditions,
- determine pavement frictional characteristics prior to restoration, and
- target pavement sites for possible rehabilitation.

53-3.04(d) Test Requests

The BMPR can perform a limited amount of friction testing. If pavement friction testing and analyses of friction numbers are desired, contact the Engineer of Pavement Technology in the BMPR.

53-3.05 Dynamic Cone Penetrometer (DCP) — NDT

53-3.05(a) DCP System

The DCP system is an instrument designed to provide a measure of the *in situ* strength of fine-grained and granular subgrades, granular base and subbase materials, and weakly cemented materials. The DCP instrument measures the penetration rate, in inches per blow, into the pavement and subgrade soil layers. Research has shown a good correlation between penetration rate and the California Bearing Ratio (CBR) of granular materials and fine-grained subgrade soils. Although the DCP instrument was developed for use on pavements with thin surfacings and natural aggregate sublayers, research has shown that the procedure also can be used on pavements with lightly cemented layers having unconfined compressive strengths of less than 440 psi.

53-3.05(b) DCP System Application

The Department typically uses the DCP system to check subgrade stability during construction, to check depth of material layers, and to provide inputs for the pavement design process. A DCP test can be performed directly through some flexible pavement cross sections or through the subbase and subgrade layers after a pavement core has been removed.

53-3.05(c) Application of DCP Test Data

The DCP test data can be used to ensure subgrade stability. Subgrade stability plays a critical role in the construction and performance of a pavement. The subgrade should be sufficiently stable to:

- prevent excessive rutting and shoving during construction, and
- provide adequate support for the placement and compaction of the remaining pavement layers.

The IDOT *Subgrade Stability Manual* requires a California Bearing Ratio (CBR) of 6 to 8 for construction purposes. The CBR value can be used to determine the necessary thickness of granular backfill or subgrade modification needed to ensure adequate subgrade stability during construction.

53-3.05(d) Test Requests

If DCP testing and analyses are desired, contact the district geotechnical engineer.

53-3.06 Destructive Testing (DT) Methods

DT methods are used to verify data obtained by NDT methods and to better examine the *in situ* condition of the pavement's structural layer, steel, and subbase materials. In general, DT methods will allow a better determination of patching potential and quantity, but at a greater cost over NDT methods (e.g., sample removal technique, traffic disruption, subsequent pavement repairs). Section 53-3.01 discusses the tradeoffs between NDT and DT methods and the need for destructive testing. The following sections present the DT methods typically used by the Department.

53-3.06(a) Pavement Slab Removal

Pavement slab removal is a DT method that requires the full-depth sawing and removal of a slab of the pavement. The length of the slab varies according to the type of pavement under study (i.e., 4.5 ft long for CRCP and 6 ft long for JRCP). Pavement slab removal permits a good visual analysis of patching potential and a complete examination of:

- "D" cracking,
- delamination,
- disintegration,
- subbase condition,
- joint condition,

- depth of steel,
- steel condition,
- depth of sound concrete, and
- loss of sound concrete in bottom and top of slab.

After the pavement slab is removed, pavement patching will be required to restore the facility and resume traffic operations. The requisite patching may be a temporary patch installed by maintenance personnel. Permanent patching then may be included in the upcoming rehabilitation contract.

53-3.06(b) Pavement Slicing

Pavement slicing is a DT method that requires the sawing and removal of a slice of the pavement, overlay, or overlaid section.

1. Concrete Pavements. The pavement slice is usually 3 in to 4 in wide and is normally cut in the transverse direction across the full width of the traffic lane. The pavement slice method, similar to the slab removal method discussed in Section 53-3.06(a), permits a good visual examination of the pavement structure. However, the slicing method does not allow complete examination of the subbase. After the pavement slice is removed, the pavement can be repaired immediately using expansion joint material. Note that slicing will disrupt the continuity of the longitudinal steel in CRC pavements. Use of the pavement slicing method may not be desirable on CRCP if the temporary repair of the transverse slice will remain for more than 2 years without permanent rehabilitation of the longitudinal steel.

2. Bituminous Concrete Overlay. The pavement slice of the bituminous concrete overlay is usually 12 in wide and is cut in the transverse direction across half of the traffic lane. The exposed face of the bituminous concrete overlay can be investigated for the presence of rutting in the various lifts. Holding a string line against the exposed face is helpful in determining which layer is significantly contributing to the surficial rutting. The pavement can be easily repaired with truck compacted hot mix or cold patch bituminous materials.

53-3.06(c) Pavement Coring

Pavement coring is a DT method that requires cutting and removing 4 in to 10 in diameter core samples from the pavement. This method is much less intrusive to the pavement than either the pavement slab removal or pavement slicing methods discussed in Sections 53-3.06(a) and 53-3.06(b). Core samples are obtained from pavements to:

- test stability of existing bituminous concrete mixes;

- perform split tensile testing of all bituminous materials;
- determine density, air voids, and stripping of all bituminous materials;
- perform compression testing of PCC;
- examine PCC for evidence of “D” cracking;
- determine horizontal limits of deterioration;
- examine AC/PCC interface bonding condition (bonded or unbonded);
- verify AC and PCC layer thicknesses;
- examine and test resilient modulus of stabilized subbase, if sample recovery is possible; and
- provide subgrade access for DCP testing.

It may be difficult to obtain an intact full-depth core sample of the stabilized subbase. Additionally, sound core samples of BAM bases are rarely recovered where taken from AC overlaid PCC pavements. Subgrade material samples needed for gradation testing may be obtained with an auger.

If split tensile testing of PCC is desired, testing should be performed on 4 in to 6 in core samples to obtain a good estimate of flexural strength. For routine pavement evaluation, 4 in diameter core samples are satisfactory for visual inspection and for bituminous concrete mixture testing. For high volume facilities where lane closures are critical, 10 in cores may be a better option. Once in the lab, 4 in core samples can be taken from the larger 10 in core for testing.

53-3.06(d) Test Responsibilities

The District materials laboratories are responsible for completing all the necessary material testing. Contact the Engineer of Technical Services in the BMPR for assistance, if needed.

53-3.07 Application of Field Test Methods

Figures 53-3A through 53-3D provide guidance for selecting appropriate field tests based on the types of distress exhibited by a particular pavement type. Use these to better develop a field sampling and testing program for the rehabilitation study.

	NON-DESTRUCTIVE				DESTRUCTIVE		
	Pavement Database Systems/ Field Observations	Falling Weight Deflectometer	Pavement Friction Testing	Dynamic Cone Penetrometer	Pavement Slab Removal	Pavement Slicing	Pavement Coring
Alligator Cracking	P	S			P	S	S
Bleeding	P						P
Block Cracking	P	S				S	P
Edge Cracking	P	S					P
Longitudinal Cracking	P	S					P
Permanent Patch Deterioration	P	S			P		S
Potholes and Localized Distress	P						S
Pumping and Water Bleeding	P	P			P		S
Raveling, Weathering, Segregation	P	S					P
Reflective Centerline Cracking	P	S					P
Reflective “D” Cracking	P					S	P
Reflective Widening Cracking	P	S					P
Rutting	P					P	P
Shoving	P					P	S
Transverse Cracking	P	S					P

Note: P = Primary Test Method; S = Secondary Test Method; Blank = Not Applicable.

FIELD SAMPLING AND TESTING FOR PAVEMENT DISTRESSES
(Asphalt Concrete (AC) Pavements)

Figure 53-3A

	NON-DESTRUCTIVE				DESTRUCTIVE		
	Pavement Database Systems/ Field Observations	Falling Weight Deflectometer	Pavement Friction Testing	Dynamic Cone Penetrometer	Pavement Slab Removal	Pavement Slicing	Pavement Coring
Blowups	P						
Corner Breaks	P	S					
“D” Cracking	P	S			S	P	S
High Steel Spalling	P					S	P
Joint/Crack Faulting	P	S			P		
Joint/Crack Spalling	P						
Joint Deterioration	P	S			P		S
Longitudinal Cracking	P	S					P
Map Cracking and Scaling	P		S			S	P
Permanent Patch Deterioration	P	S			P		
Polished Aggregate	S		P				
Pumping and Water Bleeding	P	P			P		
Transverse Cracking	P	S					P
Transverse Joint Seal Damage	P						

Note: P = Primary Test Method; S = Secondary Test Method; Blank = Not Applicable.

FIELD SAMPLING AND TESTING FOR PAVEMENT DISTRESSES
(Jointed Portland Cement Concrete (PCC) Pavements)

Figure 53-3B

	NON-DESTRUCTIVE				DESTRUCTIVE		
	Pavement Database Systems/ Field Observations	Falling Weight Deflectometer	Pavement Friction Testing	Dynamic Cone Penetrometer	Pavement Slab Removal	Pavement Slicing	Pavement Coring
Blowups	P						
Centerline Joint Spalling	P						
Closed Expansion Joints	P						
Construction Joint Deterioration	P	S			P		S
“D” Cracking	P	S			S	P	S
High Steel Spalling	P					S	P
Longitudinal Cracking	P	S					P
Map Cracking and Scaling	P		S			S	P
Permanent Patch Deterioration	P	S			P		
Polished Aggregate	S		P				
Pumping and Water Bleeding	P	P			P		
Punchouts	P				P		S
Transverse Cracking	P	S					P
Wide Flange Beam Terminal Joint	P				P		

Note: P = Primary Test Method; S = Secondary Test Method; Blank = Not Applicable.

FIELD SAMPLING AND TESTING FOR PAVEMENT DISTRESSES
(Continuously Reinforced Concrete (CRC) Pavements)

Figure 53-3C

	NON-DESTRUCTIVE				DESTRUCTIVE		
	Pavement Database Systems/ Field Observations	Falling Weight Deflectometer	Pavement Friction Testing	Dynamic Cone Penetrometer	Shoulder Slab Removal	Shoulder Slicing	Shoulder Coring
Alligator Cracking	P	S					P
Block Cracking	P	S					P
Bridge Apprch. Pvmnt./Shldr. Settlement	P	S			P		S
Lane/Shoulder Dropoff	P	P			P		
Lane/Shoulder Joint Spalling	P						
Lane/Shoulder Separation	P	S					
Transverse Cracking	P	S					P

Note: P = Primary Test Method; S = Secondary Test Method; Blank = Not Applicable.

FIELD SAMPLING AND TESTING FOR PAVEMENT DISTRESSES
(Pavement Shoulders)

Figure 53-3D

53-4 PAVEMENT REHABILITATION METHODS AND STRATEGIES

53-4.01 Pavement Rehabilitation Methods

A rehabilitation strategy normally is developed and targeted to address specific deficiencies with a particular pavement type. The strategy usually will be a combination of several rehabilitation techniques or methods that, when completed, will correct deficiencies (i.e., surface failure, structural failure, or both) in the most cost-effective manner. It is critical, therefore, that the designer understand the rehabilitation methods available and their specific applications. The following pages provide brief descriptions of the pavement rehabilitation methods typically used by the Department. Use these descriptions to better understand each rehabilitation method's purpose and application when developing alternative rehabilitation strategies.

PAVEMENT REHABILITATION METHOD

Name: Bituminous Concrete Overlay (Policy Resurfacing Program)

Application:
Pavement Type(s): All Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Asphalt overlays should be specified in accordance with the Department's policy resurfacing program as discussed in Section 53-4.05. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

Consider a request for an additional thickness exception when there is evidence of large areas of structural failure. Consult BDE.

PAVEMENT REHABILITATION METHOD

Name: Bituminous Concrete Overlay (Structural)

Application:
Pavement Type(s): All Pavements
Distress Type(s): Structural Failures

Description and Purpose:

Structural asphalt overlays should be designed and specified in accordance with the Department's pavement design guidelines and procedures presented in Chapter 54. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

Structural overlays require BDE approval.

PAVEMENT REHABILITATION METHOD

Name: 3P Program

Application:

Pavement Type(s): All Pavements

Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

The 3P program should be implemented in accordance with the procedures and guidelines presented in Section 53-4.04. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

PAVEMENT REHABILITATION METHOD

Name: SMART Program

Application:
Pavement Type(s): All Pavements
Distress Type(s): Relates to both Surface Failures and Localized Structural Failures

Description and Purpose:

The SMART program should be implemented in accordance with the procedures and guidelines presented in Section 53-4.03. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

Do not use the SMART program when the CRS distresses indicate serious structural problems. Examples are CRS distress levels L3, L4, O4, T2, T3, and T4. The SMART program may be used if minor patching will correct the distresses. Interstate highways are not eligible for the SMART program.

PAVEMENT REHABILITATION METHOD

Name: Intermittent Overlay

Application:

Pavement Type(s): All Pavements

Distress Type(s): Surface Failures

Description and Purpose:

Intermittent overlays are usually used to address isolated problem areas that continually require maintenance or patching. This procedure is best suited for sections that are not in need of overall rehabilitation except for clearly identifiable areas. The intent is to overlay only the problem area with sufficient thickness to extend the life of the area to that of the entire section when a more extensive rehabilitation can be completed. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

PAVEMENT REHABILITATION METHOD

Name: Cold Milling and Inlay

Application:

Pavement Type(s): AC Pavements, AC Overlaid PCC Pavements

Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Cold milling and inlay is the process of removing all or part of an AC overlay and placing a new AC overlay. Frequently, distresses will appear in the wheelpath of the pavement and not in the rest of the lane (e.g., rutting, reflective "D" cracking). Where this occurs, it is possible to remove the AC overlay on one half of the lane, patch the underlying pavement, and then place a new AC overlay. Sometimes a new surface course is then placed over the entire pavement to complete the rehabilitation. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

Single lift construction on Interstates will require BDE approval.

PAVEMENT REHABILITATION METHOD

Name: Cold Milling

Application:
Pavement Type(s): AC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Surface Failures

Description and Purpose:

Cold milling is the process of removing part or all of an existing bituminous concrete resurfacing. Cold milling is not recommended for concrete pavements that are to be left in service without an overlay because the surface will be extremely rough and the joints will be spalled significantly. Major uses of cold milling included the following:

- restoring the curb line of asphalt pavements;
- restoring cross slopes of asphalt pavements;
- improving friction resistance of asphalt surfaces;
- removing asphalt overlays from concrete pavements;
- removing material in conjunction with surface recycling; and
- removing material to provide a smoother surface (where the pavement is structurally adequate).

Special Considerations/Comments:

If all of the following conditions are met, milling an existing bituminous surface without resurfacing may be considered:

- the pavement is structurally sound;
- at least 3 in of the existing overlay remains in place;
- removed material is equal to existing lift (or at least 1 in of surface or 1.5 in of binder course remains);
- the existing mixture contains a high content of fines with low air voids (to prevent raveling);
- the pavement is cross sectioned (1000 ft intervals) to determine milling scheme and plan details; and
- the district bureaus review and agree upon implementation.

The following are key to obtaining a quality milled surface:

- use a good working milling machine with a 12 ft recommended width;
- control milling speed to achieve a smooth uniform surface (30 ft/min or slower for deep cuts);
- use a 30 ft ski to control grade and a stringline for longitudinal guidance;
- perform pavement patching prior to milling;
- remove pavement castings and cover holes prior to milling; and
- adjust castings after milling to meet final surface elevation.

PAVEMENT REHABILITATION METHOD

Name: Reflective Crack Control

Application:

Pavement Type(s): AC Overlaid PCC Pavements and AC Pavements
Distress Type(s): Relates to Surface Failures

Description and Purpose:

On the basis of the results of field studies conducted by the Department, the following systems have been developed for reflective crack control (RCC) of bituminous overlays:

1. System A. System A is a non-woven reinforcing fabric (see the *Standard Specifications*) that is placed on a hot applied liquid asphalt cement binder over the prepared pavement surface.

2. System B. System B is a prefabricated waterproofing membrane interlayered with woven or non-woven reinforcing fabric that is embedded in a layer of self-adhesive plasticized bitumen (see the *Standard Specifications*). A primer that is compatible with the membrane is applied on the prepared pavement surface prior to placement of System B.

3. System C. System C is a nonproprietary asphalt-rubber waterproofing membrane interlayer and cover aggregate (see the *Standard Specifications*) that is placed at a specified application rate on the existing pavement surface.

Reflective crack control is classified by the following two general types:

1. Strip Reflective Crack Control (SRCC). SRCC is suitable for use on either rigid or flexible bases and should be considered for all projects that involve resurfacing of proposed or existing widening joints or where longitudinal reflective cracks would conflict with final traffic control markings thus causing confusion to the motorist. Pavement-paved shoulder joints should not be included unless the shoulder is tied to the pavement by means of an effective load-transfer device. Systems A and C should be a minimum of 24 in wide for SRCC, and System B should be a minimum of 12 in wide. If present, the SRCC material strip should completely cover alligator cracking.

2. Area Reflective Crack Control (ARCC). ARCC is suitable only for flexible bases (e.g., full-depth asphalt, asphalt surfaces over aggregate bases, asphalt surfaces over deteriorated pozzolanic bases). ARRC is not capable of withstanding the transverse crack – producing thermal tensile stresses and vertical movements under traffic of a PCC pavement (rigid base). If transverse cracks or joints occur at intervals of less than 10 ft, the base (e.g. pozzolanic) can be treated as a flexible base. System B is not suitable for ARCC.

RCC Systems A, B, and C require a smooth substrate. All cracks should be sealed and depressions should be filled before placing any RCC material. Place System A and B materials as low as practical in the pavement structure. However, if after crack sealing and patching, the surface remains uneven for RCC material placement, a leveling binder should be used. System C, being a liquid system, is more forgiving of a rough substrate but also occasionally may require a leveling binder before placement.

PAVEMENT REHABILITATION METHOD

Name: Full-Depth CRCP Patches (Class A)

Application:
Pavement Type(s): CRCP, AC Overlaid CRCP
Distress Type(s): Structural Failures

Description and Purpose:

Class A patching consists of removing the failed pavement area and patching it with a full-depth continuously reinforced PCC patch. Where CRCP facilities are to be patched, it is important to make every attempt to maintain the integrity of the continuous reinforcement. A decision that the pavement distress is so severe that continuity cannot be maintained must be justified by district field testing and subsequent review by the Central Office. In some cases, previous contracts or maintenance activities may have resulted in the use of non-tied PCC or bituminous concrete patches being placed on a CRCP facility. Such patches should be replaced with Class A patches when rehabilitation is justified. Obtain BDE approval prior to specifying other than Class A patching for CRCP facilities. Refer to the *Highway Standards* for Class A patching details. The minimum Class A patch dimensions will be a length of 4.5 ft and a width that includes half the width of the travel lane.

Special Considerations/Comments:

It is not desirable to create the large number of closely spaced joints in a pavement that would result from placing a large number of closely spaced patches. The minimum distance between patches is 15 ft. If less than 15 ft of existing pavement will remain, the entire area between the two patches should be removed and replaced.

If PCC patching is specified on Federal-aid projects, specify the use of an early strength patching mix. Consider early strength patching mix on State-only projects, two-lane, two-way facilities, and multi-lane highways where it is not desirable to close a lane overnight. Note that it is very important to specify early strength patching mix for CRCP Class A patching to minimize steel movement in the patch as it cures.

PAVEMENT REHABILITATION METHOD

Name: Full-Depth Dowelled Patches (Class B)

Application:
Pavement Type(s): JPCP, JRCP, AC Overlaid JPCP and AC Overlaid JRCP
Distress Type(s): Structural Failures

Description and Purpose:

Class B patching consists of removing the failed pavement area and patching it with a full-depth dowelled PCC patch. For highways on the State system, including Interstate facilities, that have sound JRC pavements and less than 2% of previously placed undowelled patching, specify Class B patching regardless of whether or not the pavement will be overlaid. Class B patching also should be specified on other low-ADT routes that have existing load transfer and sound plain concrete pavements with no previously placed undowelled patches. In general, use dowelled patches on sound jointed PCC pavements. Specify undowelled patching if field testing indicates that the concrete is so unsound as to preclude the use of Class B patching. Refer to the *Highway Standards* for Class B patching details. The minimum Class B patch dimensions will be a length of 6 ft and a width that includes the full width of the travel lane.

Special Considerations/Comments:

It is not desirable to create the large number of closely spaced joints in a pavement that would result from placing a large number of closely spaced patches. The minimum distance between patches is 15 ft. If less than 15 ft of existing pavement will remain, the entire area between the two patches should be removed and replaced.

If PCC patching is specified on Federal-aid projects, ensure that the contract specifies the use of an early strength patching mix. Consider the early strength patching mix on State-only projects, two-lane, two-way facilities, and multi-lane highways where it is not desirable to close a lane overnight.

PAVEMENT REHABILITATION METHOD

Name: Full- and Partial-Depth Undowelled Patches (Class C and Class D)

Application:
Pavement Type(s): AC Pavements, JPCP, AC Overlaid JPCP
Distress Type(s): Structural Failures

Description and Purpose:

Undowelled patching may consist of either Class C or Class D patches. Class C patching consists of removing the distressed pavement area and patching it with an undowelled PCC patch. Class D patching consists of removing the distressed pavement area and replacing it with an undowelled bituminous concrete patch. Specify "Pavement Patching" to permit the contractor the option of using either PCC or bituminous concrete unless there exists a justifiable reason to specify one or the other. If a particular patch material is specified, document the basis for the material selection in the district project files.

Special Considerations/Comments:

Use the following guidelines when specifying either Class C and Class D undowelled patching:

1. PCC Pavements. Undowelled patching for PCC pavements should only be specified when field testing indicates that the concrete is so unsound as to preclude the use of Class B patching.

2. Level of Existing Patching. Undowelled patches also may be specified if there exists 2% or more of previously placed undowelled patching and the undowelled patches are in good repair.

3. Emergency Patching. Except in an emergency, Class D patching should not be specified on the Interstate system or on any supplemental freeway constructed to Interstate criteria. On such facilities, replace emergency Class D patches with permanent Class A, B, or C patches as soon as practical.

4. Full-Depth Patching. Where the multiple unit (MU) traffic is greater than 200 ADT, the minimum dimensions for full-depth patches will be a length of 4 ft and a width of half the travel lane. Where the MU traffic is 200 ADT or less, the minimum patch dimensions for full-depth patches will be as shown in the *Highway Standards* for Class C and Class D patches.

5. Partial-Depth Patching. Partial-depth patches will be 1 ft by 1 ft, minimum.

PAVEMENT REHABILITATION METHOD

Name: Fiberglass Fabric Repair

Application:
Pavement Type(s): CRCP, AC Overlaid CRCP
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

For CRC pavements showing high or medium severity "D" cracking, it is often not feasible to provide full-depth patching due to the extensive areas requiring treatment. In these situations, the best treatment often is to use an engineering fabric and to resurface the pavement as quickly as practical with minimal disturbance to the existing pavement structure. Clean those areas where the pavement is delaminated and contains loose material. The contract should provide for the removal of the loose and delaminated material and for filling the depressions created with leveling binder (i.e., hand method) prior to the placement of the fiberglass fabric repair system. Material that is delaminated but still intact need not be removed prior to placing the fiberglass fabric. Unstable bituminous mixtures previously placed by maintenance personnel to fill potholes also should be removed as part of the cleaning process.

Special Considerations/Comments:

Fiberglass fabric repair is considered to be a minimal pavement treatment.

PAVEMENT REHABILITATION METHOD

Name: Joint Resealing

Application:

Pavement Type(s): JPCP, JRCP, AC Overlaid JPCP, and AC Overlaid JRCP

Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Joint resealing is recommended to deter the intrusion of water and incompressible materials into the joint and pavement structure. Water that enters the pavement structure through the joint contributes to pumping of the underlying support material. This often results in faulting and/or cracking and corner breaks. Incompressibles that enter the joint prevent the joint from closing normally during slab expansion, which can cause spalling. Incompressibles also may contribute to pavement blowups. Note that it is not possible to construct and maintain a truly watertight joint. Therefore, resealing of concrete pavement joints on an as-needed basis is critical.

Special Considerations/Comments:

Joint resealing is necessary when the existing sealant has deteriorated to the point that it readily allows water and incompressibles to enter the joint. The primary cause of sealant failure is improper installation (e.g., resealing during hot summer months).

PAVEMENT REHABILITATION METHOD

Name: Crack Sealing

Application:
Pavement Type(s): All Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Sealing cracks in pavements helps minimize water infiltration because the crack opening is reduced or eliminated. Crack sealing consists of the repair and sealing of cracks (0.125 in to 0.75 in wide) that appear in the pavement. The crack is repaired by removing the old sealant, if necessary, routing the crack, as specified, cleaning the crack, and placing the crack sealing material. Perform a crack analysis to determine whether crack sealing would be effective. Non-working cracks narrower than 0.125 in that do not exhibit spalling should not be sealed. These cracks generally do not penetrate through the surface nor do they pose a source of pavement deterioration. The practice of sealing this type of crack by the method of pouring sealant is seldom of value.

Special Considerations/Comments:

Crack sealing may have negative effects. Undesirable visual impacts may occur, which include tracking of sealing material by tire action, obscuring lane markings, and adversely affecting skid resistance. Crack sealing may result in a rougher pavement surface when the sealant material is forced out of the cracks during warm months. The use of an asphalt-based sealant may cause a bituminous concrete surface to become over-rich in the vicinity of the crack, resulting in a softened pavement and a potential depression.

PAVEMENT REHABILITATION METHOD

Name: Crack Routing and Sealing

Application:
Pavement Type(s): PCC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Crack routing and sealing is an important rehabilitation method that often is not adequately considered. Inadequate crack routing and sealing will increase or accelerate pavement distresses caused by free water infiltrating the pavement structure. Serviceability and pavement life may be extended through proper routing and sealing of cracks that develop in the pavement. This will remove and reduce the future intrusion of incompressible materials, water, and soluble chemicals (e.g., salts and brines). For example, pavements that have experienced blowups can be treated with an adequate program of crack routing and sealing to keep additional incompressibles and water from infiltrating the pavement, thereby slowing the development of further blowups. The extent of distress caused or accelerated by free moisture in the pavement structure always should be considered. In general, if the results of a drainage survey show that moisture in the structure will accelerate or has accelerated distress, then crack routing and sealing is essential.

Special Considerations/Comments:

In some instances, full-depth patching of bare PCC pavements is specified when crack routing and sealing exists as a viable alternative. When observing the pavement condition in the field, look for locations that can be viably routed and sealed rather than patched. Use the following guidelines when making this determination:

1. Longitudinal Cracks. Long longitudinal cracks require a lengthy patch and often can be routed and sealed.

2. Narrow Cracks. Very small cracks (e.g., 0.125 in and less in width) usually do not require full-depth patching and typically can be ignored. Cracks greater than 0.125 inches in width should be evaluated for routing and sealing if the adjacent slab is sound.

3. Existing Patches. The joints at existing patches also may be routed and sealed if the only distress that is exhibited is minor spalling.

Crack routing and sealing should not be used where there are pavement blowups, rocking slabs, pumping of water or fines through the crack, or full-depth punchouts. In these instances, use full-depth patching.

PAVEMENT REHABILITATION METHOD

Name: Longitudinal Crack Repair

Application:
Pavement Type(s): All Pavements
Distress Type(s): Structural Failures

Description and Purpose:

Longitudinal crack repair is a cost-effective method of prolonging the service life of a pavement which has distress along a longitudinal crack while the rest of the pavement is sound. Many CRC pavements exhibit longitudinal cracking with severe spalling and “D” cracking adjacent to the cracks. The cost of placing a full-depth patch at these locations would be prohibitive. Instead, the crack can be milled to a depth of 2-3 in with a width of 9-18 in on either side of the crack. The milled area can then be filled with a hot mixed bituminous concrete mixture without a need to overlay the pavement. This method can also be used to repair high severity reflective cracks in AC overlays.

Special Considerations/Comments:

When using this method on bare PCC pavements, it is important to limit the depth of the milling to just above the depth of the reinforcing steel so as not to damage the steel.

PAVEMENT REHABILITATION METHOD

Name: Underdrains and Longitudinal Edge Drains

Application:
Pavement Type(s): All Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Subdrainage is an important pavement rehabilitation consideration. Water is a fundamental variable in most problems associated with pavement performance and is directly or indirectly responsible for many pavement distresses. A drainage survey may indicate that underdrains and/or longitudinal edge drains are required to control one or more sources of water in the pavement, thus increasing pavement serviceability and life. Subsurface drainage systems should be designed and constructed with long-term performance and maintenance goals in mind, including periodic inspections to check performance.

Special Considerations/Comments:

The performance of longitudinal edge drains varies depending on whether or not the pavement has a horizontally drainable layer. If no such layer exists, it usually is not practical to install edge drains to remove moisture throughout the pavement section. The moisture that infiltrates the pavement/shoulder joint usually is the only moisture that can be readily drained. A benefit to installing retrofit longitudinal edge drains is that it will remove the moisture trapped in the slab/base interface. A properly designed and constructed longitudinal edge drain system can, in some cases, improve the long-term load-carrying and distribution properties of the base and subgrade materials. Note that longitudinal edge drains by themselves cannot restore a pavement that is structurally inadequate.

Pavement distress often is accompanied by pumping of the subbase and subgrade material. For this reason, it is important to evaluate the need for underdrain installation. Pipe or drainage mat underdrains will be installed on the Interstate System and other freeway facilities that are designed to Interstate criteria, if they have not been previously installed. Although underdrains are not mandatory on non-Interstate primary facilities, they can be very useful where existing drainage problems exist. Contact the district maintenance personnel for assistance in determining locations where underdrains should be installed. Underdrains should be installed prior to patching unless there are valid reasons to do otherwise.

PAVEMENT REHABILITATION METHOD

Name: Crack Relief Layers

Application:
Pavement Type(s): PCC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Crack relief layers are used to reduce/retard the amount of reflective cracking in bituminous concrete-overlaid PCC pavements. A relatively open-graded aggregate such as CA-7 is mixed with asphalt cement and placed over the deteriorated PCC pavement. Bituminous concrete binder and surface courses are placed over the crack relief layer. The open-graded nature of the crack relief layer "absorbs" the movement caused by the cracks in the PCC pavement, effectively reducing the stress in bituminous concrete binder and surface layers, and thereby controlling reflective cracking.

Crack relief layers cover over surface defects and cracking, but obvious rocking and pumping patches must be replaced, and base failures patched. Because the crack relief layer may be several inches thick in addition to the standard overlay thickness, this rehabilitation may not be effective in areas with curb and gutter or vertical clearance problems.

Special Considerations/Comments:

Crack relief layers have been used experimentally in Illinois with some success. Approval for use of a crack relief layer must be obtained from the BDE, and an experimental features work plan must be filed with BMPR. Contact the Engineer of Technical Services in the BMPR for additional information.

PAVEMENT REHABILITATION METHOD

Name: Bonded Concrete Overlay

Application:

Pavement Type(s): PCC Pavements

Distress Type(s): Structural Failures (Including Inherent Surface Failures)

Description and Purpose:

A bonded concrete overlay (BCO) consists of a PCC overlay placed directly on top of another PCC pavement. The overlay bonds to the existing pavement to create a monolithic slab. A BCO improves the structural capacity of a pavement (i.e., its ability to carry additional traffic loadings). A BCO is a preventative maintenance method, designed for use on an adequately performing pavement to extend its life. It is not intended for use on a pavement that has reached the end of its service life.

Special Considerations/Comments:

A BCO may be used on either a JRCP or a CRCP. However, every joint or working crack in the existing pavement must be matched in the overlay, otherwise it will reflect through the BCO. Because underlying pavement distresses will reflect through the BCO, the condition of the existing pavement is a primary concern. Pavements constructed with "D" cracking aggregates are not viable candidates for a BCO. Pavements with greater than 2% patching are not suitable for a BCO. Pavements with existing asphalt concrete overlays are likewise not suitable for a BCO. In general, pavements with CRS ratings less than 6.5 should be considered for alternative rehabilitation techniques.

IDOT considers the BCO rehabilitation method an experimental technique and its use requires prior BDE approval. Contact the Engineer of Technical Services in the BMPR for assistance. The BCO has limited use because its performance is highly sensitive to the condition of the existing PCC pavement. Many factors must be taken into consideration before selecting this rehabilitation method. A comparison of rehabilitation alternatives, complete with a life-cycle cost analysis, should be conducted.

PAVEMENT REHABILITATION METHOD

Name: Unbonded Concrete Overlay

Application:
Pavement Type(s): PCC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Structural Failures

Description and Purpose:

An unbonded concrete overlay (UCO) consists of an existing concrete pavement, an interlayer, and a PCC overlay. The overlay relies on minimal structural contribution from the existing pavement. Essentially, the two layers function independently. The existing pavement acts as the subbase. The interlayer separates the two pavements. The interlayer retards reflective cracking in the overlay. Asphalt concrete is an excellent interlayer. The overlay can be JPCP, JRCP, or CRCP. A UCO is an excellent alternative for the structural rehabilitation of deteriorated concrete pavements.

Design inputs include the existing pavement thickness and condition, design life and traffic, subgrade support, and drainage conditions. A preliminary but reasonable estimate of required overlay thickness can be determined by subtracting 1 in from the thickness of a new CRC pavement calculated using the procedures discussed in Chapter 54. A minimum AC interlayer thickness of 4 in is recommended.

Special Considerations/Comments:

Consider grade alignment over at-grade structures and vertical clearance between pavement and overhead structures when selecting this rehabilitation method. Long-term planning may be necessary to ensure that structures have sufficient clearance to accommodate a UCO. Due to the increase in pavement grade, side slopes must be modified. This increased slope may require variances from existing policy. Such variances must be approved by the BDE. An additional consideration is how the overlay will be tied to the adjacent pavement or bridge section. Terminal treatments (e.g., lug systems, wide flange beams, special treatments that taper into existing sections) may need to be detailed.

Contact the BMPR for assistance in developing UCO designs (i.e., overlay and interlayer thickness requirements, terminal treatments). The suitability of a UCO depends on many factors, and each set of conditions warrants an individualized design. Costs must be considered on a case-by-case basis. Rural sections without overhead structures are ideal locations for UCOs because vertical clearance will not become an issue. Approval for use of UCOs must be obtained from the BDE. Contact the Engineer of Technical Services in the BMPR for additional information.

PAVEMENT REHABILITATION METHOD

Name: Rubblizing with AC Overlay

Application:

Pavement Type(s): PCC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Structural Failures

Description and Purpose:

Rubblizing is a rehabilitation process in which the PCC pavement is broken into small pieces (i.e., 9 in and less). The concrete/steel bond is broken, and the pavement in effect becomes a high-quality aggregate base. Rubblizing with AC overlay is an alternative to extensive pavement patching, structural overlay, or reconstruction.

The rubblizing process begins with installing drainage, if required. Existing overlays are removed and a full-depth saw cut is made to sever abutting concrete pavement that will remain in place. The pavement then is rubblized. Any reinforcement that is exposed during the rubblizing process is cut off below the surface. The rubblized concrete then is compacted with both vibratory and pneumatic rollers and the bituminous concrete overlay is placed.

Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

Rubblized pavements become free-draining aggregate bases. On Interstates and higher volume primary facilities, installation of longitudinal underdrains is necessary to provide positive drainage for the rubblized layer. A complete evaluation of the existing pavement and an in-depth subgrade soils analysis must be made prior to selecting this rehabilitation method.

Soft areas or voids located while rubblizing must be removed and replaced with sound material. Traffic must not be allowed on the rubblized pavement until a pre-determined thickness of bituminous concrete can be placed. Although it is more efficient to close both lanes of traffic during the rubblizing process, rubblizing is routinely accomplished while maintaining traffic in the adjacent lane.

Submit design proposals to the BMPR for development of individualized designs. Approval for use of the rubblizing method must be obtained from the BDE, and an experimental features work plan must be filed with the BMPR. Rubblizing is a viable rehabilitation alternative. Contact the Engineer of Pavement Technology in the BMPR for additional information.

PAVEMENT REHABILITATION METHOD

Name: Diamond Grinding

Application:
Pavement Type(s): PCC Pavements
Distress Type(s): Surface Failures

Description and Purpose:

Diamond grinding (texturing) is the use of closely spaced diamond-impregnated blades to cut longitudinal patterns into hardened concrete. The major purpose of grinding is to remove a relatively thin layer of concrete surface material and provide a smooth surface. Diamond grinding is an effective method for:

- removal of joint and crack faulting,
- removal of wheel path ruts caused by studded tires,
- correction of joint unevenness caused by slab warping, and
- restoration of transverse drainage.

Diamond grinding is a rehabilitation method that significantly improves the rideability of a pavement, but the extension of pavement life depends heavily on the effectiveness of other activities within the overall rehabilitation strategy.

Special Considerations/Comments:

Note that diamond grinding is a surface repair method because it corrects the existing faulting and wear of PCC pavements. It does nothing to correct pavement distress mechanisms. Therefore, grinding usually is performed in combination with other rehabilitation methods to both repair certain pavement distresses and prevent their recurrence.

PAVEMENT REHABILITATION METHOD

Name: Pavement Subsealing/Undersealing

Application:

Pavement Type(s): PCC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Pavement subsealing/undersealing is used to stabilize existing PCC slabs. It consists of drilling a pattern of holes through the pavement and injecting a cement grout material under pressure to fill small voids beneath the slab/base and/or base/subbase. Its purpose is to restore support to the pavement structure without intentionally raising the pavement. When the voids have been sufficiently filled, support restoration will be evident by reduced corner deflection in JPCP and JRCP and reduced edge deflections in CRCP.

Subsealing does not raise pavement depressions, increase a pavement's structural capacity, or eliminate faulting. It will, however, restore structural integrity and reduce future pumping, faulting, and slab cracking. Subsealing may be justified on sections that exhibit evidence of voids (e.g., pumping, faulted joints and/or cracks, slab rocking, depressions, excessive patching). For such sections, subsealing may be used as a short-term fix to delay future deterioration. It also may be used in conjunction with a reprofiling method or pavement overlay to improve and extend the life and performance of the pavement.

Special Considerations/Comments:

Use a multi-disciplinary committee (i.e., design, construction, operations, materials) to visually inspect and determine the exact locations where subsealing/undersealing will be justified. Pumping (indicated by the presence of holes, depressions, and/or ejected material) is almost certain evidence of voids. If areas do not exhibit physical evidence of voids but are suspect, request nondestructive testing assistance from the BMPR. Make requests as early as practical and include all comments made by the review committee. Pavement sections that contain voids often occur only on a portion of a project. Blanket subsealing rarely is justified. If subsealing is used on any portion of a project, bridge approaches within the project limits also should be subsealed. IDOT has had limited success with this method and its use requires BDE approval. Contact the Engineer of Pavement Technology in the BMPR for assistance.

PAVEMENT REHABILITATION METHOD

Name: Expansion Joints

Application:
Pavement Type(s): PCC Pavements, AC Overlaid PCC Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Expansion joints should be visually inspected to determine if they are in working order. If patching is an integral part of the rehabilitation strategy, closed expansion joints should be re-established regardless of the type of patching that is specified.

Special Considerations/Comments:

Consider the following guidelines when re-establishing expansion joints:

1. Jointed Pavements. Consider the following for jointed PCC pavements:

   a. Dowelled Patches. Where the pavement requires patching at or near a closed expansion joint, a new joint should be established using a dowelled expansion patch as shown in the *Highway Standards* for Class B patches. If the joint is closed, but does not require patching, an expansion joint may be formed by sawing the pavement and filling the saw cut with a preformed expansion joint filler material that meets the *Standard Specifications* for expansion joints.

   b. Non-Dowelled Joints. If other than dowelled patches are required and if the pavement is not being resurfaced, a new expansion joint may be formed by sawing the pavement and filling the saw cut with a preformed expansion joint filler material that meets the *Standard Specifications*.

2. CRC Pavements. If a CRC pavement is being patched with a Class A patch, whether or not the pavement is being resurfaced, existing expansion joints should be re-established using a saw cut filled with preformed expansion joint filler material that meets the *Standard Specifications* for expansion joints.

PAVEMENT REHABILITATION METHOD

Name: Lug Areas/Pressure Relief Joints

Application:

Pavement Type(s): CRC Pavements, AC Overlaid CRC Pavements

Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Lug areas that do not show signs of tilting or other similar distresses should not be cut free. If they have previously been cut free and there is no sign of tilting, the continuity of the pavement should be restored through the use of a continuously reinforced patch.

Special Considerations/Comments:

If signs of tilting exist and the pavement surface over the lug area is excessively rough, a 4 in wide pressure relief joint that is filled with a preformed expansion joint filler material should be provided 150 ft from the lug area. The entire lug system should be subsealed to fill voids, and the area over the lug should be resurfaced to complete the leveling process.

In extreme cases, the lug system should be removed and replaced with a lug system or wide flange beam expansion joint as shown in the *Highway Standards*.

PAVEMENT REHABILITATION METHOD

Name: Wide Flange Beam Terminal Joints

Application:
Pavement Type(s): CRC Pavements, AC Overlaid CRC Pavements
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

Existing wide flange beam terminal joints should be closely inspected to determine if the joint is working properly both at the beam and at the expansion joint between the beam and the bridge approach or jointed pavement. In addition, the flange of the beam should be inspected for signs of fatigue cracking.

Special Considerations/Comments:

If the pavement in the area of these joints or the beam itself show signs of distress, special patching details may be required. Contact the BDE for assistance in preparing plans for the proper remedial treatment.

PAVEMENT REHABILITATION METHOD

Name: Shoulder Rehabilitation

Application:
Pavement Type(s): Pavement Shoulders
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

See Section 53-4.07 for information on shoulder rehabilitation methods. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

Special Considerations/Comments:

PAVEMENT REHABILITATION METHOD

Name: Fog Sealing/Slurry Sealing

Application:
Pavement Type(s): Pavement Shoulders
Distress Type(s): Relates to both Surface Failures and Structural Failures

Description and Purpose:

A fog seal is a light coat of emulsified asphalt cement without any aggregate. It is designed to restore the quality of the bituminous concrete surface by preventing raveling and by sealing the shoulder surface from the effects of weathering and oxidation. A fog seal is a maintenance technique which improves surface quality. It is not designed to correct structural deficiencies.

Slurry seals are mixes consisting of well-graded fine aggregate, mineral filler, emulsified asphalt, and water. They are used for maintenance purposes rather than rehabilitative purposes. Slurry seals can be used to correct surface distresses such as oxidation, weathering and raveling, and brittle mixtures. They can seal surface cracks. Slurry seals can correct minor surface irregularities and improve the surface appearance. Slurry seals do not address underlying structural defects.

Special Considerations/Comments:

53-4.02 Guidelines for Selecting Pavement Rehabilitation Strategies

53-4.02(a) Application Matrices For Rehabilitation Methods

Figures 53-4A through 53-4D provide guidelines for selecting appropriate rehabilitation methods based on the types of distress exhibited by particular types of pavement. Use these figures to better select rehabilitation methods for the project.

53-4.02(b) Rehabilitation of Bare PCC Pavements

The rehabilitation selection matrices presented in Figure 53-4E and Figure 53-4F will assist in the development of rehabilitation alternatives for various conditions of bare PCC pavements. A multiple-bureau district team should be utilized in the decision-making process. These figures are intended to guide the team in developing viable rehabilitation alternatives based on previous knowledge and experience. The following guidelines will apply:

1. Data Collection. It is important to initially determine by a field survey the types of pavement distress being exhibited. This will provide a good indication of the pavement deterioration that can be expected in the future. A second important step is to determine the extent of patching required and the condition of the pavement that is to remain in place. A review of existing records and pavement condition surveys and the implementation of a testing program to further evaluate the condition of the existing pavement structure are essential. See Sections 53-1, 53-2, and 53-3 for additional information on these topics. Use the form presented in Figure 53-4G to assist in the data collection process. Note that it is not intended that this form become a part of the project report. Rather, it should be used as a guide for data collection and decision making and subsequently saved as background material to support the final decision and to reference for future rehabilitation needs.

2. Surface Condition. Determine the surface condition of the pavement. This includes surface wear, rutting, and polishing.

3. "D" Cracking. Determine where "D" cracking is visible. See Section 53-2 for a description of "D" cracking and associated levels of distress (i.e., Low, Medium, High).

4. New and Existing Patching. Estimate new patching quantities (including replacement of failed existing patches) and determine existing patching quantities. The quantity of existing patching may be obtained from past maintenance and contract records or by a field survey of the existing pavement. Determine whether existing patches are dowelled or tied either by checking previous contracts or by deflection testing. Use the following guidelines to rate new distress:

	Bituminous Overlay (Policy)	Bituminous Overlay (Structural)	3P Program	SMART Program	Intermittent Overlay	Cold Milling	Reflective Crack Control	Class A Patch	Class B Patch	Class C/Class D Patch	Fiberglass Fabric Repair	Crack Sealing	Crack Routing and Sealing	Crack Relief Layer	Unbonded Concrete Overlay	Rubblizing w/AC Overlay	Pavement Subsealing/Undersealing
Alligator Cracking	ML	A	ML	LL	ML	ML	ML	A	A	A					A	A	
Bleeding	A	A	A	A	A	A										A	
Block Cracking	A	A	A	A	A	A									A	A	
Edge Cracking	A	A	A	ML	A										A	A	
Longitudinal Cracking	A	A	A	A	A	A	A					ML	ML	A	A	A	
Permanent Patch Deterioration	A	A	A	A	A	A		A	A	A						A	
Potholes and Localized Distress	A	A	A	A	A	A											
Pumping and Water Bleeding								A	A	A						A	ML
Raveling, Weathering, Segregation	A	A	A	A	A	A										A	
Reflective Centerline Cracking	A	A	A	A	A	A	A					ML	ML	A	A	A	
Reflective "D" Cracking	ML	A	ML	LL	ML	A	A	A	A	A	A				A	A	
Reflective Widening Cracking	A	A	A	A	A	A	A					ML	ML	A	A	A	
Rutting	A	A	A	A	A	A										A	
Shoving	A	A	A	A	A	A										A	
Transverse Cracking	A	A	A	ML	A	A		A	A	A		ML	ML	A	A	A	

Note: LL = Low Level; ML = Medium Level; A = All; Blank = Not Applicable; Levels indicate highest severity level for which the rehabilitation method is applicable.

REHABILITATION METHODS FOR PAVEMENT DISTRESS
(Asphalt Concrete (AC) Pavements and Overlaid PCC Pavements)

Figure 53-4A

	Bituminous Overlay (Policy)	Bituminous Overlay (Structural)	3P Program	Intermittent Overlay	Reflective Crack Control	Class B Patch	Class C/Class D Patch	Fiberglass Fabric Repair	Joint Resealing	Crack Sealing	Crack Routing and Sealing	Bonded Concrete Overlay	Unbonded Concrete Overlay	Rubblizing w/AC Overlay	Diamond Grinding	Pavement Subsealing/Undersealing
Blowups						A	A									
Corner Breaks	A	A	A	A		A	A				ML		A	A	ML	ML
"D" Cracking	LL	A	LL	A	ML	ML	A	A					A	A		
High Steel Spalling	A	A	A	A		A	A					LL	A			
Joint/Crack Faulting	A	A	A	A		A	A			LL	LL		A	A	A	ML
Joint/Crack Spalling	A	A	A	A		A	A			ML	LL	ML	A	A	ML	
Joint Deterioration	A	A	A	A		A	A			LL	LL	LL	A	A	ML	ML
Longitudinal Cracking	A	A	A	A	A					ML	ML	LL	A	A	ML	
Map Cracking and Sealing	A	A	A	A											ML	
Permanent Patch Deterioration	A	A	A	A		A	A						A	A	LL	ML
Polished Aggregate	A	A	A	A											A	
Pumping and Water Bleeding						A	A						A	A		ML
Transverse Cracking	A	A	A	A		A	A			ML	ML	ML	A	A	ML	ML
Transverse Joint Seal Damage	A	A	A	A					A	ML	ML	A	A	A		

Note: LL = Low Level; ML = Medium Level; A = All; Blank = Not Applicable; Levels indicate highest severity level for which the rehabilitation method is applicable.

REHABILITATION METHODS FOR PAVEMENT DISTRESS
(Jointed Portland Cement Concrete (PCC) Pavements)

Figure 53-4B

	Bituminous Overlay (Policy)	Bituminous Overlay (Structural)	3P Program	Intermittent Overlay	Reflective Crack Control	Class A Patch	Class C/Class D Patch ∗	Fiberglass Fabric Repair	Crack Sealing	Crack Routing and Sealing	Bonded Concrete Overlay	Unbonded Concrete Overlay	Rubblizing w/AC Overlay	Diamond Grinding	Pavement Subsealing/Undersealing
Blowups						A	A								
Centerline Joint Spalling	A	A	A	A	A				ML	ML	LL	A	A	ML	
Construction Joint Deterioration	A	A	A	A		A	A			LL	LL	A	A	ML	
"D" Cracking	LL	A	LL	A	ML	A	A	A				A	A		
High Steel Spalling	A	A	A	A		A	A				A		LL		
Longitudinal Cracking	A	A	A	A	A				ML	ML	LL	A	A	ML	
Map Cracking and Sealing	A	A	A	A										ML	
Permanent Patch Deterioration	A	A	A	A		A	A					A	A	LL	ML
Polished Aggregate	A	A	A	A										A	
Pumping and Water Bleeding						A	A					A	A		ML
Punchouts						A	A								
Transverse Cracking	A	A	A	A		A	A		ML		LL	A	A	ML	

Note: LL = Low Level; ML = Medium Level; A = All; Blank = Not Applicable; Levels indicate highest severity level for which the rehabilitation method is applicable. ∗Only if Class A patches cannot be used.

REHABILITATION METHODS FOR PAVEMENT DISTRESS
(Continuously Reinforced Concrete (CRC) Pavements)

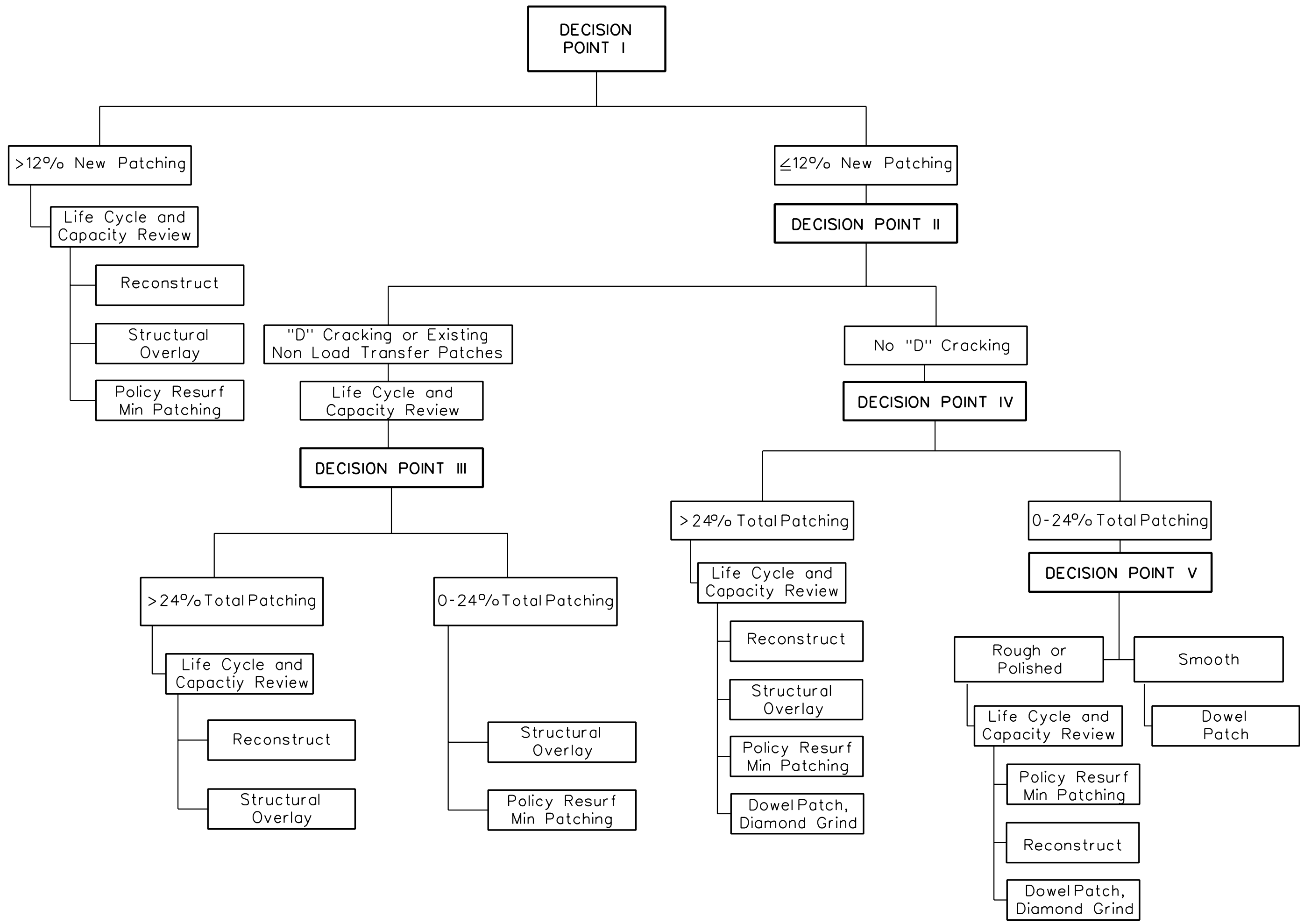
Figure 53-4C

	Crack Sealing	Crack Routing and Sealing	Crack Relief Layers	Bituminous Overlay	Partial Removal and Replacement	Complete Removal and Replacement	Fog Sealing	Slurry Sealing
Alligator Cracking			A	A		A	LL	LL
Block Cracking			A	A	A	A	LL	ML
Lane/Shoulder Dropoff				A	A	A		
Lane/Shoulder Joint Spalling				A	A	A		
Lane/Shoulder Separation	ML	ML		A	A	A		
Transverse Cracking	ML	ML	A	A		A	LL	ML

Note: LL = Low Level; ML = Medium Level; A = All; Blank = Not Applicable;
Levels indicate highest severity level for which the rehabilitation method is applicable.

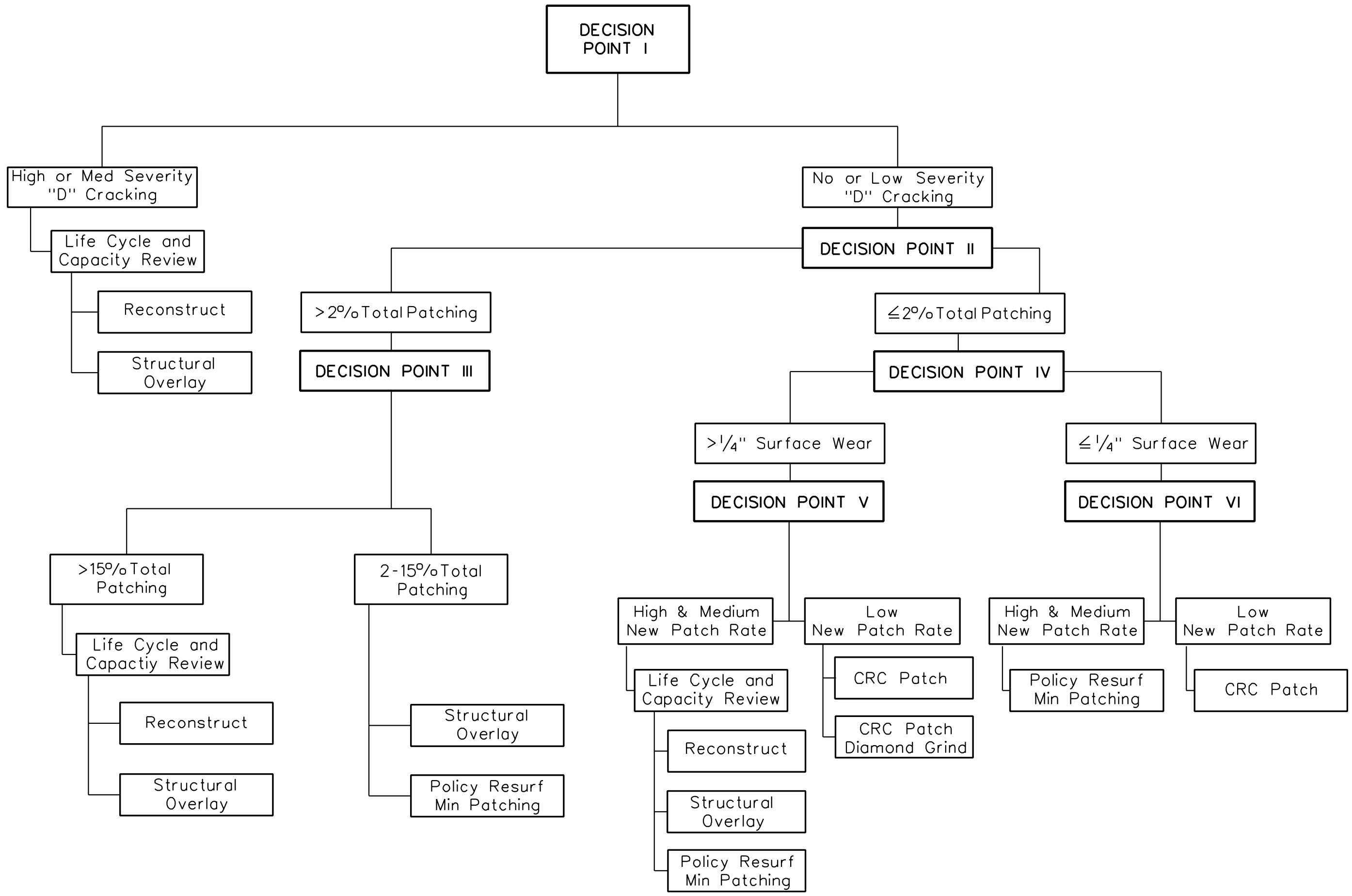
REHABILITATION METHODS FOR PAVEMENT DISTRESS
(Pavement Shoulders)

Figure 53-4D



REHABILITATION STRATEGY SELECTION
(Bare Jointed PC Concrete Pavements)

Figure 53-4E



REHABILITATION STRATEGY SELECTION
(Bare Continuously Reinforced Concrete Pavements)

Figure 53-4F

Route ____________________________
Section ___________________________
County ___________________________
Job No. ___________________________

A. BASIS FOR ESTIMATING NEW PATCHING QUANTITIES

1. _____ Quality of Existing Patches
2. _____ Pavement Age
3. _____ Needs Survey
4. _____ Transverse Cracking
5. _____ Longitudinal Cracking
6. _____ Faulted Slabs
7. _____ Joint Condition
8. _____ Blowups
9. _____ Milling of Overlaid Pavement
10. _____ Design 18K ESAL and total ESAL to Date
11. _____ Subbase Condition
12. _____ Subgrade Condition
13. _____ Punch-outs
14. _____ Pumping
15. _____ Spalling
16. _____ Slab Removal, Slice, Coring or NDT
17. _____ Depth of Steel
18. _____ Type of Reinforcement
19. _____ Experience on Similar Project
20. _____ Maintenance History

Remarks: ____
____
____
____

B. BASIS FOR DETERMINING "D" CRACKING

1. _____ Aggregate Source & Performance History
2. _____ Pavement Age
3. _____ Needs Survey
4. _____ Visual Evaluation of Staining and Cracking
5. _____ Slab Removal, Slice, Coring or NDT
6. _____ Milling of Overlaid Pavement
7. _____ Maintenance History

Remarks: ____
____
____
____

DATA COLLECTION FORM FOR REHABILITATION PROJECTS
Figure 53-4G

C. BASIS FOR DETERMINING SURFACE WEAR, RUTTING, AND POLISHING

1. _____ Friction Number
2. _____ Field Measurements
3. _____ Visual Polishing
4. ___ Accident History
5. ___ Maintenance History

Remarks: ______________________________

____

____

D. BASIS FOR DETERMINING STEEL CONDITION

1. _____ Slab Removal, Slice, Coring or NDT
2. _____ Depth of Steel
3. _____ Type of Reinforcement
4. ___ Original Design Percentage
5. ___ Maintenance History

Remarks: ______________________________

____

____

E. BASIS FOR DETERMINING FAULTING

1. _____ Field Measurements
2. _____ Condition Rating Survey
3. _____ Maintenance History

Remarks: ______________________________

____

____

F. BASIS FOR DETERMINING EXISTENCE OF LOAD TRANSFER PATCHES

1. _____ Previous Contracts
2. _____ Non-destructive Testing
3. _____ Slab Removal, Slice, Coring, NDT
4. _____ Maintenance History

Remarks: ______________________________

____

____

DATA COLLECTION FORM FOR REHABILITATION PROJECTS

Figure 53-4G
(Continued)

a. Low. Less than 0.2% new patching per year.
b. Medium. 0.2% to 0.5% new patching per year.
c. High. Over 0.5% new patching per year.

5. Total Patching. Determine the total patching quantities. Total patching quantities consist of new patching plus existing patching.

6. Reconstruction. Reconstruction may be in the form of complete removal of the existing pavement and replacement with a new mechanistically designed full-depth flexible or rigid pavement, or it may be in the form of an unbonded PCC overlay or rubblizing with an AC overlay having a design consistent with a new full-depth flexible pavement. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

7. Structural Overlays. Structural overlays include bonded PCC overlays, rubblizing, and bituminous overlays that are designed in accordance with the criteria presented in Chapter 54. Unbonded and bonded PCC overlays and rubblizing require special design procedures and prior BDE approval. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

8. Policy Resurfacing. Where policy resurfacing is specified, use the appropriate thickness guidelines presented in Section 53-4.05 for policy resurfacing, Section 53-4.04 for the 3P Program, and Section 53-4.03 for the SMART Program. Superpave mixture design criteria must be met as outlined in Section 53-4.08.

9. Minimal Patching. Several alternatives may result in a recommendation for minimal patching. If dowelled patches (Class B) are not required, then certain minimal treatments may be specified. Patch only areas exhibiting pumping or movement or significant loss of materials. Minimal patching may be either full-depth or partial-depth, CRC, dowelled, asphalt, concrete, or fiberglass repair system treatment in lieu of patching, depending on existing pavement condition and previous types of patching. Asphalt and undowelled patching only should be used on low-volume or badly deteriorated pavements. Note that drainage should be addressed in areas that exhibit pumping.

10. Life Cycle and Capacity Review. Where reconstruction or a structural overlay are identified as rehabilitation candidates, a review of the pavement's life cycle (i.e., cost, future distress, user delay problems) and capacity should be conducted to assist in the final selection. See Section 53-5.

11. Other Factors. Other factors that should be considered when making the final selection include ADT, shoulder condition, reinforcement condition, subdrainage condition, traffic control operations, constraints (e.g., bridge clearances, ramps, side slopes), desired life of the rehabilitation, condition of adjacent pavements, and costs.

53-4.02(c) Rehabilitation of AC Overlaid PCC Pavements

The predominant distresses observed in AC overlaid PCC pavements are reflective cracking, block cracking, localized distress due to “D” cracking in the PCC, AC patch deterioration, rutting, stripping, weathering, and raveling. The degree to which these distresses affect the life of the AC overlay depends on the traffic level, the thickness of the AC overlay, the quality of the AC mix, the type of original slab (e.g., JRCP, CRCP), and whether or not the PCC exhibits “D” cracking. Project-level evaluation of AC overlaid PCC pavement rehabilitation should include distress surveying, nondestructive testing, coring, and materials testing.

An AC overlaid PCC pavement is structurally deficient if it does not have sufficient structural capacity to support the anticipated traffic over its design life. The assessment of a pavement’s structural adequacy must be made within the context of a specific rehabilitation strategy because this will define the point of failure (i.e., if the pavement has a structural deficiency, its rehabilitation must incorporate a structural improvement or the rehabilitation will be short-lived). The rehabilitation strategies for AC overlaid PCC pavements are as follows:

- additional AC overlay;
- unbonded PCC overlay;
- AC overlay of rubblized PCC slab; and
- reconstruction of one or both traffic lanes.

The decision matrices presented in Figures 53-4H and 53-4I will assist in the development of rehabilitation alternatives for various conditions of AC overlaid PCC pavements. A district multiple-bureau team should be utilized in the decision-making process. These figures are intended to guide the team in developing viable rehabilitation alternatives based on previous knowledge and experience. The following guidelines will apply:

1. Underlying Philosophy. The recommended approach to rehabilitating an AC overlaid PCC pavement is based on providing the lowest total life-cycle cost over the design period. To the extent practicable, select a rehabilitation strategy that is likely to require future AC surface rehabilitation but will not require extensive future repair to the underlying layers. The key factor in this approach is the soundness of the existing pavement. The designer must differentiate those candidate pavements that will adequately perform as composite pavements, both now and in the future, from those that will not due to severe deterioration. If the underlying slab is not structurally sound due to either extensively deteriorated transverse cracks or disintegration from “D” cracking, significant repairs and thicker overlays will be required. In such cases, consider other rehabilitation strategies (e.g., rubblizing and overlay, concrete overlay, reconstruction/inlaying).

2. Data Collection. The data collection guidelines presented in Section 53-4.07(b) for rehabilitation of bare PCC pavements also apply to rehabilitation of AC overlaid pavements.

PCC QUALITY	AC MATERIAL PROBLEM	
	None or Minor	Significant or Severe
Good	- AC Overlay	- Remove/Replace AC Overlay
Fair	- AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay	- Remove/Replace AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay
Poor	- AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay - Reconstruct	- Remove/Replace AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay - Reconstruct

REHABILITATION STRATEGY SELECTION
(AC Overlaid Jointed Reinforced Concrete Pavements)

Figure 53-4H

PCC QUALITY	STEEL CONDITION	AC MATERIAL PROBLEM	
		None or Minor	Significant or Severe
Good	Acceptable	- AC Overlay	- Remove/Replace AC Overlay
Good	Poor	- AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay	- Remove/Replace AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay
Fair		- AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay	- Remove/Replace AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay
Poor		- AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay - Reconstruct	- Remove/Replace AC Overlay - AC Overlay/Rubblized PCC - PCC Overlay - Reconstruct

REHABILITATION STRATEGY SELECTION
(AC Overlaid Continuously Reinforced Concrete Pavements)

Figure 53-4I

3. Original PCC Pavement Type. Determine the original PCC pavement from historical data (see Section 53-1). There are significant differences in how an AC overlay performs on JRC and CRC pavements, especially those with and without “D” cracking. Thus, somewhat different guidelines are presented in the decision matrices for each pavement type.

4. PCC Quality. The PCC core condition, “D” cracking, and total repair area are factors that are considered in assigning an overall PCC quality rating (i.e., Good, Fair, Poor). Select the worst rating as the overall PCC quality rating. Consider the following guidelines when making this determination:

    a. PCC Core Condition. The condition of cores taken during the field testing process can be used to give a guide to the condition of the PCC pavement. Core condition is rated as follows:

        i. Good. Core is recovered intact except that a tight vertical crack may be present. Core thickness is equal to or exceeds the design thickness of the pavement. Compressive strengths, if tested, equal or exceeding 3500 psi.

        ii. Fair. Core is recovered essentially intact except that a single vertical crack and/or a single horizontal crack may be present. Small hairline cracks may be present. Core thickness is no more than 10 percent less than design thickness. Compressive strengths, if tested, equal or exceed 3000 psi.

        iii. Poor. Core is not able to be recovered intact or compressive strengths, if tested, are less than 3000 psi.

    b. “D” Cracking Severity. The “D” cracking severity rating is assigned based on the extent and severity of visible distress in the existing AC overlay reflected from underlying “D” cracking deterioration in the PCC slab (e.g., localized failures, “D” cracked joints and cracks, centerline deterioration). Consider coring in selected areas when determining the extent of “D” cracking. “D” cracking is rated as follows:

        i. Good. No evidence or knowledge of “D” cracking problems exist; or the PCC slab is known to have “D” cracking, but no “D” cracking distress is visible at the pavement surface. Core samples near joints and cracks are largely intact.

        ii. Fair. Some “D” cracking distress is visible on surface of the AC overlay. Core samples show more than half of the concrete thickness intact.

iii. Poor. Extensive “D” cracking distress is visible on the surface of the AC overlay. Core samples show less than half of the concrete thickness intact.

c. Total Percent Area of Repair. The rating for the total percent area of repair is based on the sum of the percent area of existing repairs plus the percent area of new repairs needed. Although these quantities will be needed for each traffic lane to estimate total costs for the alternative in an economic analysis, only use the outer traffic lane quantities to determine the total percent area of repair for PCC quality rating. Use the following guidelines when making this determination:

i. Percent Area of Existing Repairs. Although repairs placed after the first overlay will be visible, the percent area of existing repairs is difficult to estimate because such repairs will not be visible unless their joints have reflected through. One option is to conduct a field survey to count the repairs evidenced by reflective cracks and placed after the overlay. This usually is accurate for JRC pavements, however it is very inaccurate for CRC pavements because many reinforced concrete repairs never develop reflective cracks. A second option is to search historical maintenance and contract records to determine the quantity of repairs placed since original construction.

ii. Percent Area of New Repairs Needed. Determine the number of deteriorated reflective cracks and localized failures and prorate the result in number per mile. The percent area of required new full-depth repairs is computed by multiplying the number of repair locations by the mean area per repair (e.g., 72 ft^2 for a typical repair size of 6 ft by 12 ft), dividing the lane area per mile (e.g., 63,360 ft^2 which equals 12 ft by 5,280 ft), and multiplying by 100.

iii. Non-Load Transfer/Disintegrated Repairs. If a second AC overlay is planned, existing PCC repairs that are not reinforced in CRC pavements or dowelled in JRC pavements should ideally be replaced and therefore should be counted as new repairs needed. Full-depth AC patches and undowelled or unreinforced PCC repairs have poor load transfer and will cause rapid propagation and deterioration of reflective cracks in the AC overlay. Consult maintenance records to determine if existing PCC repairs have dowels or reinforcement. Count any new repairs needed to replace existing deteriorated repairs once as new repairs. Do not duplicate their quantity when adding new and existing repair quantities. Count AC patches and deteriorated repairs as new repairs rather than existing repairs because, unless these repairs are replaced, any new AC overlay will need to be thicker to compensate for the affect that reflective cracking will have on performance. The number of needed new repairs which are not placed is a factor in the second AC overlay thickness design.

iv. Quality Rating. Use the following table to rate total percent area of repair:

PAVEMENT TYPE	TOTAL REPAIRS (Percent Outer Lane Area)			
	< 2.5%	2.5% - 5.0%	5.1% - 7.5%	> 7.5%
AC/JRCP	Good	Good	Fair	Poor
AC/CRCP	Good	Fair	Poor	Poor

5. Drainage. When an AC overlaid PCC pavement is being evaluated for a second rehabilitation, evaluate the adequacy of the subdrainage system in place; and, if the system is not adequate, consider further subdrainage improvements in conjunction with the second rehabilitation. Pumping of fines onto the surface is a clear indication that the pavement requires a drainage improvement, regardless of whether or not a subdrainage system is in place. Deterioration of the underlying PCC slab from “D” cracking may be reduced through an improvement in subdrainage by helping to drain the excess moisture. Another major moisture-related problem in AC overlaid PCC pavements is stripping of the AC layer, which may be investigated by visually examining core samples after splitting and by observing the bond between the AC and PCC materials. If this bond is lost from stripping, severe rutting and shoving can develop in the wheel paths. Absence of any moisture-related distress suggests that the existing system is functioning and no additional improvement is warranted.

6. AC Material Quality. To assess the quality of the existing AC material, surficial AC distresses should be differentiated from deficiencies which affect the entire AC mix. Use the following guidelines to help make this determination:

   a. Weathering, Oxidation, Raveling and Block Cracking. If any of these is significant and an additional AC overlay is planned, at least 1 in of the surface or the existing surface course should be milled so that these distresses will not inhibit bonding and impair the performance of a new AC overlay. These distresses are considered surficial and not indicative of any instability or other material deficiency in the existing AC mix.

   b. Rutting and Shoving. Rutting (unusually deep, such as 1 in or more, for the overlay’s age) and shoving of the existing AC overlay suggest that the AC mix is unstable and prone to continued excessive deformation. Rutting also may be evident as localized deep depressions in the wheelpaths and upward distortion of the AC surface between the wheelpaths. In addition, rutting in excess of 0.4 in should be removed by milling if a second overlay is planned.

c. Potholes and Segregation. The presence of potholes and/or a pattern of end-of-load segregation provide a strong indication of potential debonding of the surface layer. Additional materials testing to determine adequate bond should be made if the surface layer is not to be entirely milled off.

d. Reflective Cracking. Reflective cracking of underlying PCC pavement joints, cracks, and patches can significantly impact the ride quality of an AC overlay. Thinner overlays are quickly cracked, and the ride, as measured by IRI, will become rougher. For those pavements with premature failure of the first generation AC overlay due to severe faulting or rocking of the underlying slabs, consideration should be given to an unbonded PCC overlay, rubblizing and bituminous overlay, or complete reconstruction.

e. Bleeding. Bleeding of excess asphalt cement to the pavement surface represents a material degradation due to mixture composition or construction. These areas are prone to rutting, shoving, and a loss of surface texture. Excessive areas of bleeding may indicate the presence of stripping in the bituminous mixture.

f. Tensile Strength. Tensile strength values provide a strong indication of material degradation. Consideration should be given to remove layers with poor tensile strength before placing a subsequent overlay.

g. Stripping. Stripping (i.e., loss of bond between the asphalt binder and the aggregate in the mix), represents diminished structural capacity of the AC surface. This distress indicates a material deficiency which affects the full thickness of the AC overlay. If a second AC overlay is planned and this distress is significant in the existing AC, give serious consideration to complete removal of the existing AC overlay prior to placement of any new overlay. Loss of bond between the AC overlay and the concrete slab also may result from stripping. If this has occurred, the entire AC overlay should be removed.

7. Steel Condition in CRCP. In some CRC pavements, the steel reinforcement may have corroded to the extent that many wide cracks have developed that eventually will rupture and need to be repaired. The steel's condition may be examined by coring through cracks at positions where longitudinal bars are located. The following definitions apply to typical transverse cracks that have developed in CRCP, and not to cracks that have already opened because of steel rupture:

a. Acceptable. Bar condition at transverse cracks varies from "free of corrosion" (almost new condition) to "heavy corrosion with pitting" (no significant cross-sectional area lost).

b. Poor. Bar condition at transverse cracks exhibits advanced corrosion accompanied by a marked reduction in cross-sectional area (necking down). If

10% or more of the bar samples are rated as “Poor,” the overall steel condition should be rated as “Poor.”

8. Other Factors. Other factors that should be considered in developing a complete rehabilitation strategy include adequacy of existing subdrainage, shoulder condition, traffic control options, geometric constraints (e.g., ramps, side slopes, right-of-way, overhead clearances), and the desired design life of the rehabilitation.

9. Rehabilitation Strategies. The decision matrices presented in Figures 53-4H and 53-4I will assist in the selection of the following rehabilitation alternatives for AC overlaid PCC pavements:

   a. AC Overlay. The following procedures are included in the AC overlay alternative:

      - mill the surface to remove rutting, surficial distress, and improve bond, if required;
      - repair all deteriorated cracks with reinforced (for CRCP) or dowelled (for JRCP) concrete patches; and
      - place a policy AC overlay (request exceptions for reduced thickness and structural overlays).

   b. Remove and Replace AC Overlay. The remove and replace AC overlay alternative consists of the following procedures:

      - mill off the existing AC overlay;
      - repair all deteriorated cracks with reinforced (for CRCP) or dowelled (for JRCP) concrete patches; and
      - place a policy AC overlay (request exceptions where needed).

   c. Rubblize Slab and AC Overlay. This rehabilitation alternative consists of the following four procedures:

      - mill off the existing AC overlay;
      - repair weak areas with AC or undowelled/unreinforced PCC;
      - rubblize the PCC slab; and
      - place a designed AC overlay (contact the Engineer of Pavement Technology in the BMPR).

d. Unbonded PCC Overlay. The unbonded PCC overlay is a rehabilitation alternative that consists of the following procedures:

- repair severe distresses such as punchouts and working cracks using concrete repair methods;
- if the existing overlay is excessively rutted (> 0.75 in), mill to remove the humps;
- the minimum AC interlayer thickness is 4 in (if needed, add a binder course to establish this thickness); and
- place a JRCP or CRCP overlay.

e. Remove Pavement and Reconstruct or Inlay. This rehabilitation alternative will consist of the following:

- remove the AC overlay and CRCP or JRCP;
- replace or rework the existing base as needed; and
- construct a new AC or PCC pavement designed according to the criteria presented in Chapter 54. Consider inlaying the traffic lanes if the existing shoulders can be preserved. Install subdrainage according to current IDOT design procedures.

10. Effect of Repair Extent and Overlay Design. When an AC overlay is to be placed, full-depth repair is recommended for all medium-severity and high-severity cracks, spalled joints, failed patches, and punchouts. However, due to funding limitations, it may not always be feasible to repair 100% of these structural distresses. The extent of repair actually planned will be determined on a project-by-project basis. For example, there may exist cases where the existing slab is so severely "D" cracked (and perhaps in other situations) that reinforced or dowelled repairs will be infeasible. Repairs of other types (e.g., full-depth AC patches or unreinforced or undowelled PCC patches) may be better than no repair at all.

11. Life Cycle and Capacity Review. Where reconstruction or a structural overlay are identified as rehabilitation candidates, a review of the pavement's life cycle (i.e., cost, future distress, user delay problems) and capacity should be conducted to assist in the final selection. See Section 53-5.

53-4.03 SMART Program (Not Applicable to Bare PCC Pavements)

The SMART program (Surface Maintenance At the Right Time) consists of placing thin (1.5 in (1.75 in for E-mix) thick), single-pass overlays on previously resurfaced pavements that are not in need of significant repair. Pavements with significant and extensive structural distress, such as CRS distress levels L3, L4, O4, T2, T3, and T4 are not eligible. A successful SMART program improves the ride quality and reduces the life-cycle costs of pavement rehabilitation. The average SMART project can be expected to last 7 to 10 years. If the SMART program does not appear to be capable of providing at least 5 to 7 years of service, the pavement should be rehabilitated using another resurfacing program.

For a SMART overlay to be successful, it must be applied in a timely manner. Therefore, pavement selection is critical to the project's success. If the pavement is allowed to deteriorate to a low level of service, a thin overlay will fail quickly because it cannot correct significant structural deficiencies. Conversely, if the pavement is overlaid before rehabilitation is necessary, the overlay will have been unwarranted and not cost-effective.

The selection criteria for SMART projects are presented in Figure 53-4J. Interstate highways are not eligible for the SMART program; otherwise, there are no restrictions on the eligible route classifications (e.g., marked, unmarked, rural, urban). Four-lane routes, with the exception of Interstates, may be considered if the two-lane truck and patching directional criteria presented in Figure 53-4J are met. Ramps and unmarked narrow pavements also may be considered for SMART projects. Consider local SMART project participation on a case-by-case basis. For rural facilities, ensure that the section is at least one mile in length. If deviations from these criteria are necessary, contact the BDE for approval.

53-4.04 3P Program

The 3P Program consists of repairing and resurfacing existing paved roadways on the State highway system. Unmarked roads including any urban minor arterials without a jurisdictional transfer and collector and local roads with a jurisdictional transfer are eligible to be resurfaced under this program. The purpose of the 3P Program is to provide an interim maintenance-type improvement until a rehabilitation or reconstruction improvement can be funded. The resurfacing thickness and life expectancy is the same as a policy resurfacing program. The following guidelines will apply:

1. Project Limits. Eligible projects should extend between logical termini. Rural projects should be at least one mile in length.

2. Cross Section. Total treatment will be between the edges of the existing paved roadway (travel lanes plus bituminous stabilized shoulders). Taper paved shoulders to eliminate drop-off. Include a 1 ft bituminous safety shoulder if no such shoulder exists. Existing paved bike lanes adjacent to the pavement also may be resurfaced. Urban cross-

CRITERIA	SELECTION GUIDELINES
Minimum CRS Limitations	5.0 minimum (marked routes) 4.0 minimum (unmarked routes)
Maximum CRS Limitations	6.0 maximum (marked routes) 5.4 maximum (unmarked routes)
Limits on Multiple Units/Day	< 500/day
Milling	recommended (see Note 1)
Longitudinal Crack Control	recommended (see Note 2)
Bare Concrete Pavement Resurfacing	not allowed
Resurfacing Thickness	1.5 in (1.75 in for mixture E) (see Note 3)
Patching Limitations	6% maximum (see Note 4)
3R Spot Improvements	no (See Note 6)
Safety Shoulder Additions	no (see Note 5)
Narrow Pavement Resurfacing	No (except on unmarked routes)
Raised Pavement Markers	replace existing
Geometric Improvements/Right-of-Way	not allowed except to address HAL's
M-2.12 Medians	allowed (if average project cost is under $400,000/mile)
HAL's	see Chapter 12

Notes:

1. *Use cold milling where necessary to reduce pavement irregularities and to produce a uniform surface or to correct cross slope. Milling is required where rutting is continuous and exceeds 0.25 in or where the CRS block cracking distress level is M3 or M4. Also include milling where CRS distress levels V2, V3, W3, or W4 are present. Milling need not be continuous throughout the section.*

2. *Strip reflective crack control is required where distress levels R4, R5, or S4 are present.*

3. *Exceptions are allowed for limited areas of extensive pavement distress but require approval from BDE. Consider other resurfacing programs if exception is necessary for the majority of the project.*

4. *Limit patching to no more than 6% if less than 250 MUs/day or no more than 5% if 250 to 500 MUs/day. Limit alligator or edge cracking that requires patching to no more than 4% at all traffic levels.*

5. *Include only minimal shoulder work. In urban areas, minimal curb repair may be included.*

6. *Exceptions are allowed for spot safety improvements. The following items up to 15% of the total contract cost, may be included but require approval from BDE.*

    - *Spot guardrail updates,*
    - *Minor spot drainage improvements,*
    - *Manhole or inlet adjustments off of the pavement,*
    - *Isolated ditch cleaning, and*
    - *Isolated entrance culvert replacement.*

SELECTION CRITERIA FOR SMART PROJECTS

Figure 53-4J

section limits will be face-to-face of curb with minimal repair/replacement of deteriorated curb and storm sewer inlets. Handicap ramps will be limited to intersections where existing curbs are altered. If additional work is required to meet the *Americans with Disabilities Act*, a 3R improvement is suggested.

3. High Accident Locations (HAL). See Chapter 12 for the recurring and correctable HALs that must be included in 3P projects.

4. Design. Geometric revisions, pavement widening, and right-of-way acquisition are not permitted in 3P projects. Narrow pavements with less than 1000 ADT and fewer than 200 trucks per day may be resurfaced under the 3P program.

5. Pavement. See Section 53-4.05 for resurfacing thickness criteria and exceptions. Patching should be kept to a 10% maximum. Bituminous pavements may be milled prior to resurfacing. The use of reflective crack control treatment for longitudinal widening and centerline cracks is required when CRS distress levels S4, R4 or R5 are present.

6. Bridges. Structurally deficient or functionally obsolete bridges should be gapped and addressed through other programs. Any resurfacing or other minor work on a bridge within the limits of the project is permitted, but will require coordination with and approval by the Bureau of Bridges and Structures.

7. Design Exceptions. Candidate 3P projects will be discussed at district coordination meetings. Design exceptions will require BDE review and approval.

53-4.05 Policy Resurfacing Program and Exceptions

The policy resurfacing thicknesses presented in this section were developed primarily for rigid pavements. The resurfacing thicknesses presented in this section also apply to most flexible pavements, other than full-depth flexible pavements designed using mechanistic procedures (see Chapter 54). However, if a flexible pavement exhibits medium to high levels of base failures, as evidenced by alligator cracking or other similar distresses, contact the Engineer of Technical Services in the BMPR for guidance in designing the overlay. Mechanistically designed flexible pavements also should be referred to the BMPR for design assistance if other than standard overlays that are called for in the regular maintenance schedules are required. Note that this section presents policy guidelines for maximum thicknesses. In cases where resurfacing is being placed for cosmetic reasons, such as when widening joints and lane lines conflict, or in cases where a standard policy is not needed, it may be desirable to place less than the policy thickness. Submit such requests to the BDE for approval. Approval will be based on supporting documentation.

53-4.05(a) Interstates and Freeways Built Essentially to Interstate Criteria

Current policy expects pavement rehabilitation projects on Interstates and freeways built essentially to Interstate standards to perform at least 8 to 10 years. Historical data and IDOT experience indicate that the criteria in this Section will meet this performance period. However, variations do exist within and between projects, and thicker overlays are sometimes required. Requests for deviations in thickness, both less than and greater than the policy, should be submitted to the BDE for approval. Approval will be contingent on supporting documentation. Use the following guidelines to determine resurfacing thickness for Interstates and arterials:

1. Standard Policy. Standard resurfacing thickness for overlays will be 3.75 in. This will allow for a 2.25 in binder coarse lift and a 1.5 in surface coarse lift.

2. Subsequent Resurfacings. For second and subsequent resurfacings on Interstate highways and freeways, consider cold milling of the pavement to true up the pavement surface. The district will determine the feasibility of milling and the appropriate milling depth. Pavements with rutting depths greater than 0.50 in should be investigated further to determine the cause of rutting. Greater milling depths may be required to completely remove badly rutted or unstable mixtures. Any failed patches should be replaced. Second resurfacings of "D" cracked pavements may warrant an additional resurfacing thickness. Contact BMPR and BDE for assistance in evaluating these situations.

3. Structural Deficiency Exceptions. Pavements that meet any of the following conditions should be considered candidates for a 5 in overlay exception.

   - JRC pavements that exhibit medium to high levels of "D" cracking over at least 30% of the project and CRC pavements that exhibit low to medium levels of "D" cracking over at least 30% of the project;

   - JRC and CRC pavements with excessive total patching quantities which can be reduced by the additional overlay thickness;

   - JRC pavements with average faulting in excess of 0.5 in (faults in excess of 0.75 in should be patched); and/or

   - JRC or CRC pavements with current traffic levels in excess of 7500 heavy commercial units per day.

53-4.05(b) Other State Maintained Highways

Current policy expects pavement rehabilitation projects on other State maintained highways to perform for least 8 years. Historical data and IDOT experience indicate that, for the majority of previously resurfaced pavements, a 2.25 in overlay will exceed the required performance period. Cold milling to remove rutting and similar pavement distresses also should be considered. Variations do exist within and between projects, and thicker overlays are sometimes required. Requests for deviations in thickness, both less than and greater than the policy should be submitted to the BDE for approval. Approval will be contingent on supporting documentation. Use the following guidelines to determine resurfacing thickness for other State maintained highways:

1. Standard Policy. Standard resurfacing thickness calls for a 2.25 in overlay. On those highways where the existing concrete has not been resurfaced, or where widening is being placed, the standard overlay thickness should be increased to 2.5 in. Projects should be designed to this criteria unless an exception can be justified.

2. Exception 1 — Jurisdictional Transfer. Requests for additional resurfacing thickness will be approved only if the transfer is approved by the accepting agency. The amount of additional thickness should be held to the minimum that will allow the transfer to be accomplished. A field review conducted by the Pavement Review Team may be required for projects that include unusual or experimental treatments.

3. Exception 2 — Consistency. Projects that border on new or reconstructed sections with 15 year or greater design periods may qualify for additional thickness. Design the overlay for the same design period using the composite pavement design method that is presented in Chapter 54. Projects that contain an urban cross section with new curb and gutter also may qualify for additional thickness. Design the overlay for a 15 year design period using the composite pavement design method. Ensure that design calculations accompany any request to the BDE. Figure 53-4K presents coefficients (based on average conditions) that may be used to evaluate new and old pavement materials at various periods to determining the thickness of the structural overlay required.

4. Exception 3 — Profile Corrections. Current policy requires a cross slope of 1.5% for new construction to promote cross drainage and prevent the ponding of water on the pavement surface. Most existing pavements constructed with circular crowns contain adequate cross slope to achieve this objective. For this reason, crown correction normally will not be required in resurfacing contracts. Where, due to uneven settlement or other reasons, a minimum cross slope of 1% is not available, first consider cold milling to obtain the proper crown. If cold milling is not feasible, prepare plans for crown correction using a 1.5% cross slope for the required resurfacing thickness.

5. Exception 4 — Structural Deficiency. The following pavements may qualify for a 3.75 in overlay:

    - pavements with severe base failures;

    - JRC and CRC pavements with excessive total patching quantities that can be reduced by the additional overlay thickness;

STRUCTURAL MATERIALS	MINIMUM STRENGTH REQUIREMENTS			COEFFICIENTS		
	MS①	IBR	CS②	New Pavement	1st Resurfacing	2nd Resurfacing
Bituminous Surface				a_1	a_1'	a_1''
Road Mix (Class B)				0.20	0.15	0.11
Plant Mix (Class B)						
Liquid Asphalt				0.22	0.16	0.12
Asphalt Cement	900			0.30	0.23	0.17
Class I (1954 and before)				—	0.23	0.17
Class I (1955 and later)	1700			0.40	0.30	0.23
Superpave IL9.5 & IL12.5 (4% voids)				0.40	0.30	0.23
Base Course				a_2	a_2'	a_2''
Aggregate, Type B						
Uncrushed		50		0.10	0.08	0.06
Crushed		80		0.13	0.10	0.08
Aggregate, Type A		80		0.13	0.10	0.08
Waterbound Macadam		110		0.14	0.11	0.09
Bituminous Stabilized Granular Material	300			0.16	0.12	0.09
	400			0.18	0.14	0.11
	800			0.23	0.17	0.13
	1000			0.25	0.19	0.15
	1200			0.27	0.21	0.16
	1500			0.30	0.23	0.17
	1700			0.33	0.25	0.20
Superpave Base Course				0.30	0.23	0.17
Superpave IL19.0 (4% voids)				0.33	0.25	0.20
Pozzolanic, Type A			600	0.28	0.22	0.16
Lime Stabilized Soil			150	0.11	0.09	0.07
Select Soil Stabilized			300	0.15	0.12	0.09
with Cement			500	0.20	0.15	0.11
Cement Stabilized Granular Material			650	0.23	0.17	0.13
			7500	0.25	0.19	0.15
			1000	0.28	0.22	0.16
Subbase Course				a_3	a_3'	a_3''
Granular Material, Type B		30		0.11	0.09	0.07
Granular Material, Type A						
Uncrushed		50		0.12	0.10	0.08
Crushed		80		0.14	0.11	0.09
Lime Stabilized Soil			100	0.12	0.10	0.08

Notes:

① *Marshall Stability (MS) index or equivalent.*

② *Compressive strength (CS) in pounds per square inch (psi). For cement stabilized soils and granular materials, use the 7 day compressive strength that can be reasonably expected under field conditions. For lime stabilized soils, use the accelerated curing compressive strength at 120°F for 48 hours. For Pozzolanic, Type A, use the compressive strength after a 14 day curing period at 72°F.*

STRUCTURAL COEFFICIENTS FOR FLEXIBLE PAVEMENT MATERIALS

Figure 53-4K

- JRC pavements with average faulting in excess of 0.5 in;
- JRC, CRC, and overlaid concrete pavements exhibiting “D” cracking; and
- pavements with a current CRS rating of 3.9 and less.

6. Exception 5 — Heavy Traffic. Class I, II, and III primary highways with heavy traffic that have not been previously resurfaced will be eligible for additional resurfacing thickness as shown in Figure 53-4L. The current ADT will be used for eligibility determination and should be submitted with the request. First and subsequent resurfacing projects for which substantial increases in traffic are expected (as in the case of detours), and projects for which commercial traffic travels fully loaded in one direction and empty in the other will be considered special cases and will be referred to the BDE and BMPR for analysis.

53-4.05(c) Documentation for Exception Requests

For all facility types, include the following information in the documentation submitted to the BDE for overlay thickness exception requests:

1. Length and Limits of Project/Limits of Request. If the condition of the section is variable, clearly define the limits of the distressed areas that require additional thickness by station or log mile rather than requesting additional thickness over the entire project.
2. Traffic. Document traffic volumes including breakdown of passenger vehicles, single-unit trucks, and multiple-unit trucks.
3. Pavement History. Include the date of construction, pavement cross-section data, date and description of previous rehabilitations, current CRS rating, and distress history.
4. Existing Condition. Include the type, severity, and frequency of distress (including photos); directional differences, faulting measurements; rutting measurements; patching quantities for the standard policy overlay versus the reduced patching quantities with the additional thickness overlay and the costs associated with both options.
5. Core Data. Information on the quantity, location, and type of pavement cores should be included. Additional information on the material characteristics of those cores, including: densities (%), air voids (%), tensile strength (psi), conditioned tensile strength (psi), and stripping (numeric rating) should also be included.
6. Calculations and Estimates. Include all relevant supporting calculations and cost estimates.
7. Other. Include any other supporting evidence and test data and photographs.

MULTIPLE UNITS/DAY (2-way traffic)	EQUIVALENT THICKNESS OF EXISTING PCC SLAB (D_C)*	OVERLAY THICKNESS
MU < 500	All	2.5 in
500 ≤ MU ≤ 1000	$D_c \leq 7.5$ in $D_c > 7.5$ in	3.75 in 2.5 in
1000 < MU ≤ 1500	$D_c \leq 8.5$ in $D_c > 8.5$ in	3.75 in 2.5 in
MU > 1500	All	3.75 in

FIRST RESURFACING FOR CLASS I, II, AND III PRIMARY HIGHWAYS
Figure 53-4L

**Note: See Figure 54-6C for values of D_c.*

Usually, the required documentation can be contained in a simple memo that will not require extensive work on the part of the designer. Based on the content of the submittal, the total length of the project, and the percent of the project for which additional or reduced, overlay thickness is requested, a joint field review with the district and the Pavement Review Team (PRT) may be warranted.

The PRT consists of members from the BDE, BMPR, and OPP as well as the district. The PRT serves a vital role in the selection of appropriate and cost-effective rehabilitation strategies for individual projects and assists in identifying and prioritizing rehabilitation strategies that provide long-lasting, high-quality rehabilitations without compromising the overall quality of the highway network. Additionally, the PRT is responsible for conducting State-wide reviews of all Interstates.

In many cases, a joint field trip with the PRT will not be necessary if the exception request is of a standard nature or involves minor deviations. It is often possible for the PRT to review the pavement section using the CRS video logging database. To facilitate such reviews, include the Tape Set Number and Frame Reference in the request. If the request is properly documented in such cases, the PRT may grant the exception without a need for additional action.

53-4.05(d) Waterproofing and Surfacing of Bridge Decks

It is extremely difficult to obtain the desired density in the Superpave bituminous concrete surface course for lift thickness less than 1.75 in because 0.5 in of the overlay thickness will be reserved for the waterproofing membrane system (i.e., membrane plus sand asphalt protection layer). This would result in a thin lift of Superpave surface course remaining which cannot be compacted to the required density. The minimum Superpave surface course thickness that can be adequately compacted is 1.25 in for a IL-9.5 or CA 16 mixture or 1.5 in for a IL-12.5 or CA 13 mixture. Therefore, for all projects on which plans are developed for waterproofing and surfacing bridge decks, specify a minimum 1.75 in thick overlay for a IL-9.5 or CA 16 mixture or a minimum 2.0 in thick overlay for a IL-12.5 or CA 13 mixture to adequately accommodate both the waterproofing membrane system and the Superpave surface course.

53-4.05(e) Resurfacing of Stabilized Shoulders

Stabilized shoulders should be resurfaced in conjunction with pavement resurfacing. The following guidelines apply:

1. Rehabilitation. Survey existing stabilized shoulders to determine their condition and the type and amount of work necessary to properly repair the base. Specify shoulder resurfacing to the nominal thickness of the resurfaced pavement. Guidelines for shoulder rehabilitation are presented in Section 53-4.07.

2. Cross Section. For Interstate highways, the width of shoulder stabilization should equal the nominal width of the existing stabilized shoulder, except that in no case will the resurfaced shoulder width be less than 10 ft right and 4 ft left. However, where the existing stabilized shoulder also is current design width for new construction, the top width of the resurfacing may be reduced at the rate of 1 in for each 1 in of resurfacing thickness. The shoulder cross slope may be increased from 4% to a maximum of 6%, except where adjacent to superelevated pavements where the high side shoulder should be sloped so that the algebraic difference between the pavement and shoulder slopes does not exceed 8%. Make spot checks of the elevation of the outer edge of the shoulder and determine a shoulder slope that will provide for a minimum thickness of new bituminous material of not less than 1.5 in. Show this shoulder slope on the typical cross sections included in the plans.

3. Heavy Trucks. Where the existing Interstate shoulder width is 10 ft and heavy truck DHV is 250 or more, stabilized shoulder widths may be increased to 12 ft.

4. Underdrains. Consider using the material excavated from the pipe underdrain trench to bring the area outside of the stabilized shoulders to the proper level after resurfacing the shoulders. If this material is to be utilized, include a special provision requiring the contractor to limit the top size of the material to 3 in. If this material is unsatisfactory or if underdrains are not placed on the project, specify the use of Aggregate Shoulders, Type B.

53-4.05(f) Pipe Underdrains

If longitudinal pipe underdrains have not been previously installed under the shoulders on Interstate highways or supplemental freeways constructed to Interstate criteria, they should be installed as part of the rehabilitation strategy. Ensure that underdrain installation is conducted prior to patching, unless there exists a valid reason to do otherwise. Only specify underdrain installation on primary facilities where existing drainage problems warrant.

See the *Highway Standards* for underdrain installation details for Interstate highways. Depending on the type of underdrain material specified, it may be necessary to adjust the depth of the underdrain to accommodate outfall drainage into existing shallow roadside ditches. Ensure the depth is sufficient to prevent overstressing the underdrain material. Generally, pipe will not be overstressed if the trench depth is 24 in or greater. Consult the Engineer of Products Evaluation in the BMPR for guidance if it is necessary to place pipe in shallower trenches. A special provision to limit the type of underdrain material may be necessary when these conditions exist. In addition, if deep roadside ditches or high fills are encountered, give consideration to shifting the locations of pipe drain laterals to avoid outfall onto the long steep slopes. Replace any aggregate outlets of existing outfall pipe drains with concrete headwall outlets. If pipe underdrains have been installed on a previous contract, conduct an investigation to determine the need for cleaning or repairing the underdrain system.

53-4.06 Rehabilitation of Interchange Ramps

Two practices are currently being utilized by the Department for the rehabilitation of interchange ramps. These practices are staged ramp construction and temporary ramp closure. The most common practice is staged ramp construction which utilizes half of the ramp pavement width and adjacent shoulder to carry traffic while the remaining ramp pavement and opposite shoulder work is performed. Staging allows traffic patterns to be maintained, but involves hazardous driving and working conditions, longer construction times, and higher construction costs. Temporary ramp closures provide for a safer work zone, shorter construction time, and lower construction costs but does require adverse public travel. Each interchange should be evaluated on a case-by-case basis to determine which practice to use.

Temporary ramp closure should receive first consideration. The impact of temporary ramp closure on local businesses, schools, residential areas, and emergency services should be evaluated to determine if it is acceptable from a local public relations standpoint. If the ramp closure impacts are not acceptable, then use the staged ramp construction alternative. If the staged ramp construction alternative is used, the existing shoulders should be evaluated for their ability to handle the additional traffic load. If the impacts of temporary ramp closure are acceptable, the detour for the ramp closure should be evaluated in the same manner as other detours in a Traffic Management Analysis (see Chapter 13). An economical comparison then can be made between the two practices.

If pavement patching will be performed during staged ramp construction, ensure that no open holes, broken pavement, or partially filled holes remain overnight. If project conditions justify leaving patch excavation open overnight, document this fact in the project files and forward a copy to the BDE for approval.

53-4.07 Rehabilitation of Shoulders

53-4.07(a) General Requirements

The following general requirements apply to Interstate shoulder rehabilitation:

1. Subsurface Drainage. Where practical, design pipe underdrains in accordance with the *Highway Standards.* Pipe underdrains may be installed shallower than that shown in the *Highway Standards* if existing roadway ditches so dictate. The depth generally should not be less than 24 in to prevent overstressing the pipe. Consult the BMPR if it is necessary to place the pipe in shallow trenches.

2. Pipe Drain Outlets. Specify concrete headwalls to replace aggregate outlets on existing pipe drains.

3. Shoulder Width. Reconstructed bituminous shoulders should conform to existing shoulder width or policy width, whichever is less. Minimum mainline shoulder widths will be 10 ft right and 4 ft left. For Interstate ramps, the minimum shoulder width is 4 ft left and 6 ft right.

4. Shoulder Wedge. The existing earthen wedge at the outer edge of the stabilized portion of the shoulder will be removed and replaced with Aggregate Shoulders, Type B or material salvaged from the existing shoulder. In areas where the existing guardrail is in good condition and it has been determined that drainage of the shoulder subgrade is not a problem, the wedge may remain in place. However, if the contractor must remove the guardrail to construct the stabilized portion of shoulder, then the wedge also should be replaced.

5. Shoulder Slopes. Where the rehabilitation requires more than a surface treatment, provide shoulder cross-slopes as shown in the *Highway Standards*.

6. Shoulder Thickness. For shoulders requiring rehabilitation other than a surface treatment or minimal bituminous overlay, the shoulder thickness at the pavement edge will be the same as the pavement thickness, but not less than 8 in, and the outer edge will not be less than 8 in. In the Chicago Metropolitan Area, the minimum thickness will be 12 in.

53-4.07(b) Rehabilitation Alternatives

Depending on the condition, thickness, and composition of the existing shoulder, rehabilitation may consist of one of the following alternatives:

1. Surface Treatment. Consider an emulsion seal where the asphaltic matrix has oxidized to the point that there exists raveling potential. An A-1 or A-2 surface treatment may be

specified where the shoulder structure is basically sound but the surface course exhibits segregation or raveling. Patch isolated areas of distress prior to placing the surface treatment.

2. Bituminous Overlay on Granular or Stabilized Base. A bituminous concrete overlay with new or recycled material may be utilized where deterioration is restricted to the top few inches of surface and where the existing shoulder structure has considerable thickness, a portion of which can be used as a base for the new shoulder. In such cases, it may be necessary to mill existing shoulders to place sufficient overlay thickness. The rehabilitated shoulder section should have a minimum flexible structural number of 2.78 to be equivalent to an 8 in full-depth bituminous shoulder and a minimum structural number of 4.24 to be equivalent to a 12 in shoulder (see Chapter 54). For bituminous concrete material, assign a coefficient of 0.33 when determining the structural number. For granular bases, use a coefficient of 0.11 for uncrushed and 0.13 for crushed granular bases. Cement and bituminous stabilized bases that are in sound condition should be assigned coefficients of 0.28 and 0.33, respectively. Unsound stabilized bases should be assigned the appropriate coefficient for granular material.

3. Partial Removal and Replacement. Existing shoulders where the majority of distress is confined to a location 1 ft to 2 ft adjacent to the pavement or outer edge may be rehabilitated by replacing the distressed areas with a full-depth bituminous concrete mixture meeting the minimum thickness criteria. A surface treatment also may be necessary to seal the remaining portion of the existing shoulder and to avoid a patchwork appearance. In such cases, document the details of the general condition survey, location, nature, and extent of distress to justify that less than total removal and replacement will be practical and cost-effective.

4. Complete Removal and Replacement. Where complete removal and replacement (new or recycled mix) is required, provide a shoulder thickness in accordance with the minimum thickness and structural number criteria. If partial or complete removal and replacement is required, consider recycling the existing material in place. Contact the BMPR for assistance in determining recycling potential and in evaluating the structural adequacy of the existing shoulder.

5. Shoulder Dropoff. Where the shoulder drop-off at the pavement edge exceeds 1.5 in but no other shoulder rehabilitation is necessary, ensure that the deficiency is corrected in the rehabilitation strategy. Use a tapered wedge of either a suitable bituminous concrete mixture or emulsion stabilized cold mix.

6. High-Use Areas. Give special attention to shoulders in high-use areas (e.g., weigh stations, rest areas) where repeated truck parking is observed. At such locations, it may be necessary to design a stronger shoulder structure to accommodate the additional weight of loaded trucks.

53-4.07(c) Settlement of Bridge Approach Shoulders

Existing bridge approaches constructed to previous design criteria may exhibit evidence of voids under the approach pavement and shoulders. The presence of voids usually results in the settlement of the bridge approach pavement and shoulders due to the settlement of the backfill material at the abutments. The Department's current *Highway Standards* provides adequate treatment of this potential problem. Use this criteria on all future construction projects that involve State-maintained bridges and stabilized shoulders. Also consider this treatment on those projects involving State-maintained bridges and turf or aggregate shoulders. All four corners of the bridge structure should be treated. If drainage is not required, omit the inlet as directed in the *Highway Standards*. Coordinate with the district Bureau of Operations to verify problem locations at existing bridges and consider the following guidelines when developing shoulder rehabilitation strategies:

1. Major Settling (Unstable). If major bridge approach shoulder settlement (i.e., 2 in or greater) exists and continues to settle (or a drainage problem exists) and the bridge is within the limits of a proposed construction project, include Bridge Approach Shoulder Pavement as part of the contract. Shoulders in these areas should be excavated and voids under the bridge approach pavement slabs should be filled by mudjacking or by other approved methods (e.g., bituminous undersealing, cement grout, flowable fill). Use expansion anchor ties to tie the approach shoulder pavement to both the approach pavement and the abutment.

2. Major Settling (Stable). If major settlement exists but the area is no longer continuing to settle and the bridge is within the limits of a proposed construction project, it may be sufficient to include shoulder resurfacing as part of the contract (filling low spots to provide a level surface). Contact the district Bureau of Operations for assistance in making this determination.

3. Consolidated Bridge Approach Rehabilitation Projects. If the distress conditions listed in Item 1 or 2 above exist at two or more bridges but no other road construction is planned for the area, consolidate the bridge approach shoulder rehabilitation work into a single set of project plans.

4. Minor Settling. If settlement is minor (i.e., less than 2 in) and drainage is not a problem, use field tests to verify those locations where voids are suspect beneath the approach pavement and shoulders. If voids exist, shoulder rehabilitation should be provided as described above. If the presence of voids is not found to exist beneath the approach pavement or shoulders, the district Bureau of Operations will provide the necessary corrective treatment to keep the shoulders up to grade.

5. Guardrails. During the implementation of shoulder rehabilitation work, ensure that proper guardrail post positioning is maintained to shield the bridge ends (see the *Highway Standards*). Problems may be encountered when placing Bridge Approach Shoulder Pavement adjacent to some wingwall and end post configurations. If problems

are encountered, consider using oversized or double blockouts to correct the problem. Consult the BDE for assistance with such problems.

53-4.07(d) Shoulder Rumble Strips

Shoulder rumble strips are an effective method to reduce run-off-the-road crashes. They provide a very cost effective means of alerting motorists that they are drifting off the pavement. They do, however, present difficulties for bicyclists and pedestrians and should not be used in locations where their use would present a problem to this segment of the population.

As part of the rehabilitation strategy, specify shoulder rumble strips (if they do not already exist) for shoulders on Interstate highways and other freeways built to Interstate criteria and on all rural expressways with posted speeds > 50 mph. Specify rumble strips on primary highways at HALs identified by the Division of Traffic Safety and at locations with known run-off-the-road crashes that have adequate paved shoulder width. Provide rumble strips at other locations on a case-by-case basis. On facilities where bicycles are permitted, special design considerations will be needed if the available clear paved shoulder outside width is less than 6 ft.

Refer to Section 34-2.02(d) for additional discussion.

53-4.08 Superpave Design Guidelines

These guidelines apply to all bituminous concrete construction. Although the guidelines may list all of the available options allowed in Superpave, the District Materials Engineer should always be consulted for the determination of each aspect of the Superpave criteria.

Superpave, the final product of the Strategic Highway Research Program (SHRP), was developed as a system for specifying asphalt materials. It stands for Superior Performing Asphalt Pavements and represents a basis for specifying component materials, designing and analyzing bituminous concrete mixture designs, and predicting pavement performance. It is an improvement over previous mixture designs because Superpave designs mixtures for specific locations, climate, and traffic.

The Special Provision, "Superpave Bituminous Concrete Mixtures", must always be used in conjunction with the Special Provision, "Quality Control/Quality Assurance of Bituminous Concrete Mixtures." If reclaimed asphalt pavement (RAP) is to be allowed in the Superpave mixture, insert the Special Provision, "RAP for Use in Bituminous Concrete Mixtures."

Figure 53-4M was designed to accommodate Superpave mixtures and is required to be completed and inserted into the General Notes of the project plans.

The following mixture requirements are applicable for this project:

Location(s):	
Mixture Use(s):	
PG:	
RAP %: (Max)**	
Design Air Voids:	
Mixture Composition: (Gradation Mixture)	
Friction Aggregate:	
Mixture Weight:	

** *Note: If > 15% RAP is used, the District Materials Engineer may require the use of a softer grade of asphalt.*

SUPERPAVE MIXTURE REQUIREMENTS

Figure 53-4M

Use the following guidelines to complete the table in Figure 53-4M:

1. Location(s): Specify, by route number or stationing, the location(s) where the mix will be placed.

2. Mixture Use(s): Corresponds to the generic description of the mixture(s) (i.e., surface course, level binder, base course, shoulders, etc.). On full-depth projects, specify the lift (e.g., "full-depth, lower binder", "full-depth, top binder", or "full-depth, surface").

3. PG: In Superpave designs, the asphalt cement is referred to as binder. Specify the Performance-Graded (PG) binder for the mixture, including polymer modified asphalt cement (e.g., PG64-28, SBR or SBS-PG64-28, PG70-22, SBR or SBS-PG70-22). Obtain the required PG binder designation from the District Materials Engineer. For additional information on PG binders and AC equivalents, see Section 53-4.02(c).

4. RAP%: Specify the maximum RAP percentage allowed in the mixture (e.g., 0%, 10%, 15%, 25%, etc.). RAP is not allowed in any mixtures that contain polymers. For additional information on RAP, see Section 53-4.08(d).

5. Design Air Voids: Specify the target air void content for the mixture. For example, Superpave may require "4.0% @ N_{design} = 50", "4.0% @ N_{design} = 70", etc. All Superpave projects, with the exception of some shoulder and low ESAL (< 0.3 million) mixtures, will

require 4.0% air voids; however, the N_{design} number will change. The target air voids for base course, stabilized subbase, shoulders and low ESAL mixtures will be included in the corresponding special provision. Obtain the N_{design} number from the District Materials Engineer.

6. Mixture Composition: Specify the aggregate gradation for the mixture design:

   a. Gradation Selection. Specify the aggregate gradation for Superpave design applications:

      - IL-25.0 – coarse binder (i.e., Mixture A).
      - IL-19.0 – binder (i.e., Mixture B).
      - IL-19.0L – low volume binder.
      - IL-12.5 – surface or level binder.
      - IL-9.5 – surface or level binder.
      - IL-9.5L – low volume surface.

   b. Surface Mixture. The gradation designation indicates the nominal maximum aggregate size in mm. When specifying a surface mixture, list both IL-12.5 and IL-9.5 for the mixture composition. The actual mixture composition used for the project is the contractor's option.

   c. Binder/Level Binder Mixtures. Binder mixtures have a larger top size aggregate, are placed in thicker lifts, and are used for structural purposes. IL-19.0, IL-19.0L and IL-25.0 mixtures are binder mixtures. Level binder mixtures have a smaller top size aggregate, are generally placed in thinner lifts, and are used for leveling purposes. IL-9.5 and IL-12.5 mixtures are level binder mixtures.

7. Friction Aggregate: Specify the aggregate to be used to meet surface course friction requirements (i.e., Mixture C, Mixture D, Mixture E, Mixture F). Because there are no friction requirements for binder courses, leave this entry blank when specifying binder courses. Refer to Section 53-4.08(e) for additional information.

8. Mixture Weight: Specify the unit weight used to determine the plan quantities for bituminous concrete surface course. Use 112.0 lb/sq yd/in thickness as the unit weight for typical standard mixes. For a specialty mix design, such as those with steel slag or a stone matrix asphalt (SMA), which only allow one specific coarse aggregate, the designer should consult the District Materials Engineer to determine the anticipated unit weight.

53-4.08(a) ESAL Calculation

In Superpave designs, use Section 54-2.01(c) to calculate ESALs for the design lane. To select the PG binder and design compactive effort (N_{design}), the ESAL value, equivalent to the Traffic Factor (TF), is calculated according to the equations in Figure 54-5B. For Superpave designs, use a Design Period (DP) of 20 years. In this application, the calculation is purely to determine the mixture design parameters; actual pavement/thickness design may require a different design period and/or TF calculation. Minimum structural design traffic levels should be ignored for Superpave mixture design purposes.

It is recommended that each district designate a single individual to coordinate ESAL calculations. In instances where major routes cross district borders, it is recommended that the ESAL counts be confirmed between districts.

53-4.08(b) Design Compactive Effort

In the past, the laboratory compactive effort was defined by Class I and Type (i.e., Type 1, Type 2, Type 3). Now, with Superpave, the design compactive effort is expressed as an N_{design} number, which is selected based on the estimated 20-year ESAL loading of the traffic lane.

Figure 53-4N lists the design compactive effort (N_{design}) required for the different levels of traffic loading and describes the typical roadway application. These are guidelines. Consult the District Materials Engineer for the appropriate N_{design} value.

53-4.08(c) Binder/Asphalt Cement

Performance-Graded (PG) binders will now be specified in place of viscosity grades of asphalt cement (i.e., AC-10, AC-20). This does not mean the asphalt cement will be polymer modified; rather, the specification defines the asphalt cement based on the climate and pavement temperatures for which it is expected to serve. In Superpave, “binder” refers to the asphalt cement, not the “binder layer”. Consider the following:

1. Polymer Modified Performance-Graded Binders. Where polymer modifiers are required, designate “SBS or SBR” in front of the PG binder requirements in the General Notes table. The following grades of asphalt cement must be polymer modified: PG70-28, PG76-22, and PG76-28. When specifying PG64-28 or PG70-22, check with the District Materials Engineer to verify the use of polymer, because these grades can be manufactured and applied without being polymer modified.

2. Applications. Figure 53-4O lists the common allowable PG binders, the previous asphalt cement equivalent, and possible applications.

3. Binder Selection. Based on Design ESALs and the Traffic Load Rate, the PG binder may be “bumped” to a higher binder grade. The binder selection options provided in Figures 53-4P and 53-4Q are based on the recommendations of the Illinois-Modified AASHTO MP-2 provisional standard in the *Manual of Test Procedures for Materials*.

Design ESALs (millions) (20-yr. Design)	N_{ini}[1]	N_{des}[1]	N_{max}[1]	TYPICAL ROADWAY APPLICATION
< 0.3	5	30	42	Roadways with very light traffic volume such as local roads, county roads, and city streets where truck traffic is prohibited or at a very minimal level. (Considered local in nature; not regional, intrastate, or interstate.) Special purpose roadways serving recreational sites or areas may also be applicable.
0.3 to 3	6	50	74	Includes many collector roads or access streets. Medium-trafficked city streets and the majority of county roadways.
3 to 10	7	70	107	Includes many two-lane, multi-lane, divided, and partially or completely controlled access roadways. Among these are medium-to-highly trafficked streets, many state routes, US highways, and some rural interstates.
10 to 30	8	90	141	May include the previous class of roadways which have a high amount of truck traffic.
> 30	8	105	167	Includes US Interstates, both urban and rural in nature. Special applications such as truck-weighing stations or truck-climbing lanes on two-lane roadways may also be applicable to this level.

[1] N_{ini} and N_{max} are for informational purposes only. It is recommended the air voids at N_{ini} be greater than 11 % to avoid mix tenderness. Also, air voids at N_{max} should be greater than 2% to prevent premature rutting.

DESIGN COMPACTIVE EFFORT FOR VARIOUS TRAFFIC CONDITIONS

Figure 53-4N

PG GRADE	PREVIOUS EQUIVALENT	APPLICATIONS
PG64-22	AC 20	Overlays Full-Depth Pavements
PG70-22 SBR or SBS-PG70-22	AC 40 or MAC 20	Overlays Full-Depth Pavements
SBR or SBS-PG76-22	MAC 20HD	Overlays Full-Depth Pavements
PG64-28 SBR or SBS-PG64-28	AC 20 or MAC 10	Full-Depth Pavements
SBR or SBS-PG70-28	MAC 10HD	Full-Depth Pavements
SBR or SBS-PG76-28	MAC 10HD+	Full-Depth Pavements
PG58-22	AC 10	Local Agencies
PG58-28	AC 7.5	RAP Mixtures
PG52-28	AC 5	Local Agencies RAP Mixtures
PG46-28	AC 2.5	Local Agencies

PG BINDER APPLICATIONS

Figure 53-4O

Illinois N_{design} Number	Design ESALs[1] (million)	PG Binder Grade[5] [7]		
		Traffic Load Rate		
		Standard[4]	Slow[3]	Standing[2]
30	< 0.3	PG58-22	PG64-22	PG64-22[6]
50	0.3 to < 3	PG64-22	PG70-22 SBR or SBS-PG70-22	SBS-PG76-22
70	3 to < 10	PG64-22	PG70-22 SBR or SBS-PG70-22	SBS-PG76-22
90	10 to < 30	PG64-22[6]	PG70-22 SBR or SBS-PG70-22	SBS-PG76-22
105	≥ 30	PG70-22 SBR or SBS-PG70-22	PG70-22 SBR or SBS-PG70-22	SBS-PG76-22

Notes:

1. *Design ESALs are the anticipated project traffic level expected on the design lane over a 20-year period. Regardless of the actual design life of the roadway, determine the design ESALs for 20 years and choose the appropriate N_{design} level.*

2. *Standing Traffic - where the average traffic speed is less than 12 mph.*

3. *Slow Traffic - where the average traffic speed ranges from 12 mph to 43 mph.*

4. *Standard Traffic - where the average traffic speed is greater than 43 mph.*

5. *The binder grade provided in the table is based on the recommendations given in Illinois-Modified AASHTO MP-2, Table 1, "Binder Selection on the Basis of Traffic Speed and Traffic Level."*

6. *Consideration should be given to increasing the high temperature grade by one grade equivalent.*

7. *Consider increasing the high temperature grade by one grade and/or use polymer modified binder within 2500 ft upstream of the exit terminal stub to 2500 ft downstream of the entrance stub at weigh stations.*

PG BINDER GRADE SELECTION – OVERLAYS
Figure 53-4P

APPLICATION	PG BINDER GRADE [5,6,7]		
	STANDARD[4]	SLOW[3] TRAFFIC OR HIGH[1] ESALS	STANDING[2] TRAFFIC
Districts 1 - 6			
Surface	SBR or SBS-PG64-28	SBR or SBS-PG70-28	SBR or SBS-PG76-28
Top Binder	SBR or SBS-PG64-28	SBR or SBS-PG70-28	SBR or SBS-PG76-28
Lower Binders	PG64-22	PG64-22	PG64-22
Districts 7-9			
Surface	PG64-22	SBR or SBS-PG70-22	SBR or SBS-PG76-22
Top Binder	PG64-22	SBR or SBS-PG70-22	SBR or SBS-PG76-22
Lower Binders	PG64-22	PG64-22	PG64-22

Notes:

1. *High ESALs – where ESALs are > 30 million.*
2. *Standing Traffic - where the average traffic speed is less than 12 mph.*
3. *Slow Traffic - where the average traffic speed ranges from 12 mph to 43 mph.*
4. *Standard Traffic - where the average traffic speed is greater than 43 mph.*
5. *The binder grade provided in the table is based on the recommendations given in Illinois-Modified AASHTO MP-2, Table 1, "Binder Selection on the Basis of Traffic Speed and Traffic Level."*
6. *Consider increasing the high temperature grade by one grade for ESALs 10 to 30 million.*
7. *Consider increasing the high temperature grade by one grade and/or use polymer modified binder within 2500 ft upstream of the exit terminal stub to 2500 ft downstream of the entrance stub at weigh stations.*

PG BINDER GRADE SELECTION – FULL-DEPTH PAVEMENT

Figure 53-4Q

SUPERPAVE MIXTURES	MAXIMUM % RAP	
N_{design}	Binder/Leveling Binder	Surface
30	30	30
50	25	15
70	15	10
90	10	10
105	0	0

Note: RAP is not allowed in mixtures containing polymer modifiers. Designate 0% on the plans where SBR or SBS-PG binders are specified.

MAXIMUM RAP PERCENTAGES

Figure 53-4R

a. Overlays. Most overlays should use the grades shown in Figure 53-4P for a standard traffic level. Adjustments to this grade are dependent upon conditions such as slow moving traffic, high ESALs, or standing traffic. These modifications should be made according to Figure 53-4P for the corresponding N_{design} number and/or ESAL number. The appropriate binder grade should then be reported on the General Notes table of the plans.

b. Full-Depth. Full-depth pavements should be designed using the PG binders shown in Figure 53-4Q. The appropriate binder grade should be reported on the General Notes table of the project plans.

53-4.08(d) RAP

Use Figure 53-4R to determine the maximum allowable RAP percentage. Districts should specify the correct maximum RAP percentages on the General Notes table of the project plans.

53-4.08(e) Friction Aggregate

A Superpave bituminous concrete surface course must be specified for each rehabilitation/resurfacing project. The Illinois Wet-Pavement Crash Reduction Program (TRA-16), effective February 4, 2000, lists the selection criteria of the surface course material for construction and rehabilitation/resurfacing of pavements.

Before the appropriate mix is selected, determine whether or not the segment is a wet-pavement cluster site. If the segment is a wet-pavement cluster site, refer to "A Procedure for Identifying, Analyzing, and Improving Wet-Pavement Crash Locations Within Rehabilitation/ Resurfacing Projects," which is included in the "Illinois Safety Improvement Processes" maintained by the Bureau of Operations. This procedure discusses the available options for wet-pavement cluster sites.

It is not desirable to specify short, closely spaced segments of special high-quality friction mixes (i.e., patchwork surfacing). If a special high-quality friction mix treatment is required at more than one location on a project and the distance between locations is less than 1,000 ft, the gaps should also be treated with the special mix. Also, if the special treatment is required on more than 50 percent of the project, it should be used throughout the project.

For areas other than wet-pavement cluster sites, four surface course mixtures have been developed that will provide adequate skid resistance for various Average Daily Traffic (ADT) levels: Mixtures C, D, E, and F. Figure 53-4S designates the ADT levels allowable for each of the surface course mixtures.

NUMBER OF LANES	FRICTIONAL REQUIREMENTS (ADT)			
	Mixture C	Mixture D	Mixture E	Mixture F
≤ 2	≤ 5,000	> 5,000	N/A	N/A
4	≤ 5,000	5,001 to 25,000	25,001 to 100,000	> 100,000
≥ 6	N/A	5,001 to 60,000	60,001 to 100,000	> 100,000

Note: ADT levels are for the expected year of construction.

FRICTIONAL REQUIREMENTS FOR SURFACE MIXTURES

Figure 53-4S

53-5 LIFE-CYCLE COST ANALYSIS (LCCA) FOR REHABILITATION PROJECTS

This section provides guidance on conducting Life-Cycle Cost Analyses (LCCA) for pavement rehabilitation projects to assess the long-term cost effectiveness of alternative rehabilitation strategies.

53-5.01 Purpose of LCCA

LCCA is an analytical technique, based on the principles of economic analysis, that evaluates the overall long-term economic efficiency among competing alternative rehabilitation strategies. LCCA does not, however, address equity issues. It incorporates initial and discounted future Department, user, and other relevant costs over the life of candidate alternatives. LCCA attempts to identify the best value for investment expenditures (i.e., the lowest long-term cost that satisfies the performance objective). Note that LCCA is a decision support tool, and the results of using LCCA are not decisions in and of themselves. The logical analytical evaluation framework that life-cycle cost analyses foster is as important as the LCCA results themselves. It is essential that all impacts be accurate for LCCA results to be meaningful.

53-5.02 LCCA Procedures

LCCA should be conducted as early in the project development cycle as practicable. For rehabilitation projects, the appropriate time for conducting the LCCA is during the alternatives evaluation stage of Phase I. The level of detail included in the LCCA should be consistent with the level of investment. Typical LCCA models that are based on primary rehabilitation strategies can be used to reduce unnecessarily repetitive analyses.

LCCA need only consider differential costs among rehabilitation alternatives. Costs common to all alternatives will cancel out and should not be included in the analysis. Inclusion of all potential LCCA factors in every analysis is counterproductive; however, all LCCA factors and assumptions should be addressed, even if only limited to an explanation of the rationale for not including eliminated factors in detail. Sunk costs, which are irrelevant to the analysis, should not be included.

53-5.03 LCCA Guidelines

Consider the following guidelines when conducting life-cycle costs analyses to assess rehabilitation project alternatives:

1. LCCA Analysis Period. The LCCA analysis period, or the time horizon over which rehabilitation alternatives are evaluated, should be sufficient to reflect long-term cost differences associated with reasonable strategies. An analysis period of 30 to 40 years is reasonable for rehabilitation projects.

2. Economic Efficiency Indicator. Net present value (NPV) is the economic efficiency indicator of choice. The uniform equivalent annual cost (UEAC) indicator is also acceptable, but should be derived from NPV. Computation of benefit/cost (B/C) ratios are generally not recommended because of the difficulty in determining costs and benefits for B/C ratios.

3. Dollar Type. Future cost and benefit streams should be estimated in constant dollars and discounted to the present using a real discount rate. Although nominal dollars can be used with nominal discount rates, use of real/constant dollars and real discount rates eliminates the need to estimate and include an inflation premium. In any given LCCA, real/constant or nominal dollars must not be mixed (i.e., all costs must be in real dollars or all costs must be in nominal dollars). Furthermore, the discount rate selected must be consistent with the dollar type used (i.e., use real cost and real discount rate or nominal cost and nominal discount rate).

4. Discount Rate. The Department uses a discount rate of 3% for new pavements and this rate is acceptable for rehabilitation.

5. Overhead Costs. Although most analyses include traditional Department construction costs, some do not fully account for the Departments engineering and construction management overhead. This can be a serious oversight on short-lived rehabilitation projects as the Department's design processes potentially lengthen in an era of downsizing.

6. Annual Maintenance Costs. Routine, reactive-type annual maintenance costs have only a marginal effect on NPV. They are hard to obtain, generally very small in comparison to initial construction and rehabilitation costs, and differentials between competing rehabilitation strategies are usually very small, particularly when discounted over a 30- to 40-year analysis period.

7. User Costs. User costs are the travel time delay, vehicle operating, and crash costs incurred by highway users. The LCCA should primarily focus on work zone user cost differences between alternatives, especially on travel delay when demand exceeds work zone capacity for an alternative. User costs are heavily influenced by the current and future traffic demands, facility capacity, circuitous detours, and the timing, duration, and frequency of work zone-induced capacity restrictions. Directional hourly traffic demand forecasts for the analysis year in question are essential for determining work zone user costs. The vehicle classes analyzed should include passenger vehicles, single-unit trucks, and combination trucks. See Chapter 13 for additional information on work zone user costs.

8. Salvage Value. Salvage value should be based on the remaining life of an alternative at the end of the analysis period.